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Industrial Lighting Reflectors.

WHILST there is general recognition of the continual progress that is being made in lighting, one recent development—the tendency towards standardisation—deserves special notice. It marks a new stage in illuminating engineering. Lighting is in many respects a very difficult field for standardisation. In the case of most problems, there are many different aspects to consider, and as new lamps and appliances are being constantly introduced, the whole subject is in a state of continual development.

There are, however, some directions in which standardisation would obviously be beneficial. Several of these were indicated at the recent meeting of the Illuminating Engineering Society, when the B.E.S.A. specifications for portable photometers (No. 230/25) and industrial reflector fittings for electric lighting (No. 232/26) were discussed. The former specification should have the effect of materially raising the standard of accuracy and workmanship of photometers; the latter is of particular value as showing the willingness of leading manufacturers of reflectors to adopt standard principles of design.

Discussion of the last-mentioned was concerned mainly with its leading feature—the adoption of an "angle of cut-off" of 20 deg. for reflectors of the enamelled-iron "R.L.M." type. The Home Office Departmental Committee on Lighting in Factories and Workshops has already recommended that, with a view to avoiding glare, the angle between the line drawn from the eye of the operator to the filament and a horizontal plane should not be less than 20 deg. (except in the case of sources within six feet of the operator, where an angle of 30 deg. is specified). Reflectors with an angle of cut-off of 20 deg. could therefore be used in practically any position in a factory without fear that the conditions would be unduly glaring. This is obviously a great advantage. The Home Office Committee made it clear that its requirements could be met in various ways—for example, even very shallow reflectors can be used if located at a sufficient height so as to be out of the direct range of vision. But a user of the standardised R.L.M. reflector would know that he was taking no risks.

One fact brought out very clearly in this discussion, but not sufficiently generally realised, is that angle of cut-off and efficiency are closely related. The more completely the flux of light from a lamp is enclosed by the reflecting source the greater in all probability will be the loss of light. The general opinion seems to be that

enamelled-iron reflectors of this type with a cut-off angle of 20 deg. should have an efficiency of the order of 60 to 65 per cent. Estimates of efficiency of industrial reflectors are apt to be somewhat fanciful; there are certainly very many reflectors in use with an efficiency very much less than the value mentioned above.

The term "efficiency" is often abused. Here is a striking case in which the more "efficient" apparatus is not necessarily the more serviceable. If, for example, one imagines a reflector consisting of a flat disk a comparatively long way above the lamp, intercepting only a small fraction of the light rays, it is apparent that it might have an efficiency of nearly 100 per cent.—simply because it is inactive, and discharges none of the functions of a proper reflector. British manufacturers will do well to continue to aim at the production of reflectors with suitable screening properties and a cut-off angle of at least 20 deg., even though this may occasion some sacrifice of nominal efficiency.

Whilst this specification relates primarily to one particular standard form of fitting—the enamelled-iron reflector of the R.L.M. type—it should be understood that there are other possible methods of eliminating the glare, for instance, by the use of opaque or translucent rings so placed as to screen the source at all angles likely to bring it within the range of vision. By these and other methods sufficient protection against glare, coupled with higher efficiency and desirable properties as regards very extensive distribution of light, may be obtained, and a promising form of fitting of this type was exhibited at the meeting of the Illuminating Engineering Society. The specification, therefore, should not operate as a bar to progress, and may require revision from time to time.

One other point of great importance requires to be noted—the necessity for standardisation of lamps in order that they may give predetermined results in standardised reflectors. In the past much trouble has been caused by variations in the dimensions of lamps of the same wattage. In some cases the dimensions were such that the filament came too far within the reflector; in other cases the filament projected right outside the reflector, giving rise to glare. In either case the expected distribution of light from the reflector would not be obtained, and hence the predetermined conditions of illumination would not be realised.

In order that reflectors designed in accordance with the specification may operate properly, it is of great importance that the position of the centre of the filament with respect to the cap of the lamp should be standardised so that the light source will be located as nearly as possible always in the same place within the reflector. Excellent progress has already been made by the B.E.S.A. Lamp Committee in the direction of standardisation, and lamp manufacturers will no doubt co-operate in the fixing of limits which will ensure yet greater precision in the future.

The Training of Electrical Power Engineers.

Whilst the Electrical Power Engineers' Association in its earlier years devoted its attention mainly, and with ample justification, to securing reasonable remuneration for its members, it has always been proclaimed by the leaders of the Association that it had higher aims—namely, to raise the status of power engineers and, to that end, to improve the training of recruits to their ranks. In this resolve it has enlisted the sympathy and support of the Employers' Side of the National Joint Board, and a scheme drawn up by that Board has been under consideration by the District Joint Boards for some time. We have now received a copy of the scheme as approved by the N.J.B. and recommended for adoption by the District Boards and supply undertakings.

In a brief introduction it is pointed out that modern systems of supply are so complex that the engineers who supervise their operation and maintenance must needs be highly trained; they are responsible for very costly plant, for the continuity of supply, and for heavy outlay, demanding technical knowledge of considerable extent, and the scheme is designed to ensure their possession of the necessary qualifications. A Register of trained engineers is to be established, recording the names of men who have been suitably trained, but there is no intention of restricting employment to those on it.

The National and District Joint Boards will not attempt to supervise the course of training until the men who have completed an approved course in engineering works present themselves for admission to the electricity supply industry, but they will appoint sub-committees to collaborate with the firms concerned and with technical colleges, and to keep in touch with the progress of the trainees during their training within the supply industry and afterwards. The preliminary training involves three or four years spent in a manufacturing engineering works, unless the candidate follows a three-year day course at a technical college or university, in which case the works training may be reduced to two years; and the two years' training within the industry must be spent in an undertaking having not less than 8,000 kW of plant installed. The total period of training in any case must extend over six years, and the candidate must pass a test for proficiency, which may be the A.M.I.E.E. or other approved examination.

The scheme as a whole is commendably brief, practical, and businesslike, and should prove effective in removing the uncertainty which has hitherto surrounded the question of training for the electricity supply industry and in placing it on a higher plane. We are specially pleased to see that it is regarded as essential that the engineer shall possess a knowledge of the commercial side of the industry. The want of this qualification has been a heavy handicap to the industry in the past, and if electricity supply is to be developed as it should be, it is imperatively necessary to include adequate commercial training in the curriculum.

The Electricity (Supply) Bill.

That the Bill would be given a second reading by the House of Commons was a foregone conclusion. The debate, which occupied two days, was in many respects interesting; the Bill was praised for widely different reasons, and no less diverse were the arguments advanced in opposition to its progress, some of which, as was pointed out at the time, were mutually destructive. At this stage, of course, the broad principles embodied in the Bill were alone in question, the details being a matter for the Standing Committee. A brief report of the debate is concluded in this issue.

Unfortunately, as might be expected from the nature of the subject and want of acquaintance with its intricacies on the part of the speakers, misconception of the situation and misinformation as to the actual facts largely detracted from the value of the discussion. Not a little of the latter was due to the Weir Committee's report; in the course of the Attorney-General's closing speech, for example, he made use of a table from the Report purporting to compare the consumption of electricity in this country with that in eleven places abroad, of which only one was truly comparable and relevant. No wonder that such figures were stigmatised by a member as "deliberately misleading"!

It would be tedious to review the debate at length, but we may sum up the result in a few words: a Bill of some kind is essential to repair the damage done by the House of Lords to the Bill of 1919; this Bill is not satisfactory, but can be greatly improved in Committee; when all is said and done, it will not give cheap electricity to everybody—distribution still remains as costly as ever; and, what is of the first importance, progress is being brought to a standstill whilst the electricity supply industry, including the Electricity Commission, awaits the verdict of Parliament. Since the autumn of 1924 numerous schemes of local development received by the Commissioners, and certain schemes devised by them, have had "necessarily to be deferred pending a decision by the new Government as to the policy to be followed. The brake is on all the time—and the slow progress resulting from its application is used as an argument against the industry!

Electrical Progress in Pretoria.

The New Municipal Generating Station.

THE first electricity supply installation in Pretoria, which was established in 1891, consisted of five belt-driven generators, and it is interesting to record that Mr. T. C. Wolley-Dod, the present electrical engineer to the Town Council, assisted in the transportation of these units by ox wagons. Within ten years the output of the station had increased to six times that of the original demand, and between 1891 and 1919 the station was reconstructed three times on the original site; and in 1902 it was taken over by the Municipality. Subsequently Mr. G. M. Clark, M.A., M.Inst.C.E., who was appointed as consulting engineer to the undertaking, decided that it was necessary to build a completely new power house equipped with turbine-driven generating plant. A site, convenient for coal and water supplies, was chosen some three miles from the centre of the city, and it was proposed that the new station should be designed for an initial output of 10,000 kW, and that the original station (Schoeman Street) should be used as a converter station and equipped with five 750-kW motor converters. The new station, fig. 1, stands 4,360 ft. above the sea level.

Fig. 1.—Pretoria Generating Station.

The first work to be put in hand was the construction of a dam, by which it was possible to store 100 million gallons of water, with a top-water surface of 35 acres, for cooling the circulating water by natural evaporation.

The power station is of reinforced-concrete monolithic structure, and all the stresses are carried on beams and columns; the foundations are taken direct on to the rocky shale, the bases of the concrete columns being carried to this solid foundation. An important feature in the construction of the building is the provision of large windows on all sides, freely admitting natural light to the semi-basement engine room. The boiler and engine rooms and all the machinery are on the same level, which was determined by the minimum water level to be anticipated in the dam.

The boiler equipment consists of six Babcock and Wilcox marine-type boilers, fig. 5, with electrically-driven chain stokers. Each boiler has a normal capacity of 20,000 lb. per hour, and is fitted with a steel-tube economiser with a main flue above. The chimney stacks are 7 ft. 6 in. in diameter, and are fitted with induced-draught fans. Coal is brought to the sidings in hopper-bottomed trucks, the largest of which is capable of a load of 50 short tons (2,000 lb.). It is belt conveyed to bucket elevators, from which a second conveyor discharges it into overhead steel bunkers, whence it travels, *via* chutes, to the boilers. At the top of each chute is a coal valve which discharges 700 lb. at each filling. About 100 tons of coal is kept in the overhead bunkers, and provision is made for storing and handling up to 3,000 tons on site.

The pump room lies between the engine room and boiler house, and Weir feed pumps, 6,000 r.p.m., are installed, each having a capacity of 7,000 gal. per hour against full pressure. The boiler feed water is taken into drums, from which it is distributed to either or both of the duplicate feed ranges; and a motor air compressor supplies air to all parts of the station for various purposes, including soot blowing from the boiler tubes.

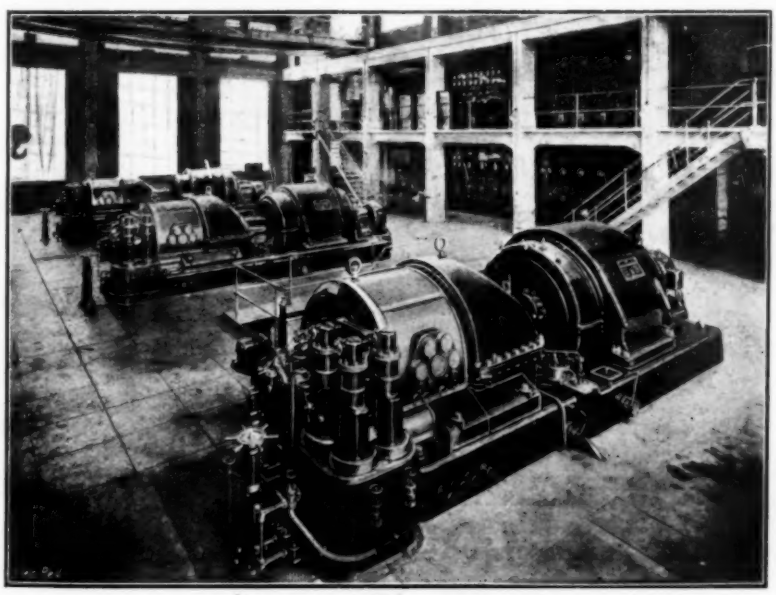


Fig. 2.—Turbine Room.

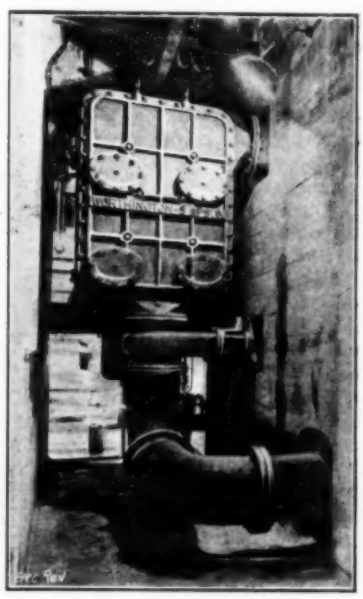


Fig. 3.—6,000-sq. ft. Condenser.

The turbine room, fig. 2, is equipped with three 3,500-kVA, General Electric Co., Ltd., turbo-alternators, running at 3,000 r.p.m., the turbines being of the impulse type designed for a working steam pressure of 350 lb. per sq. in. gauge, with a total temperature of 600 deg. F., and a 95 per cent. vacuum. The steam supply to each turbine is controlled by three throttle valves automatically operated by the governor through oil relays.

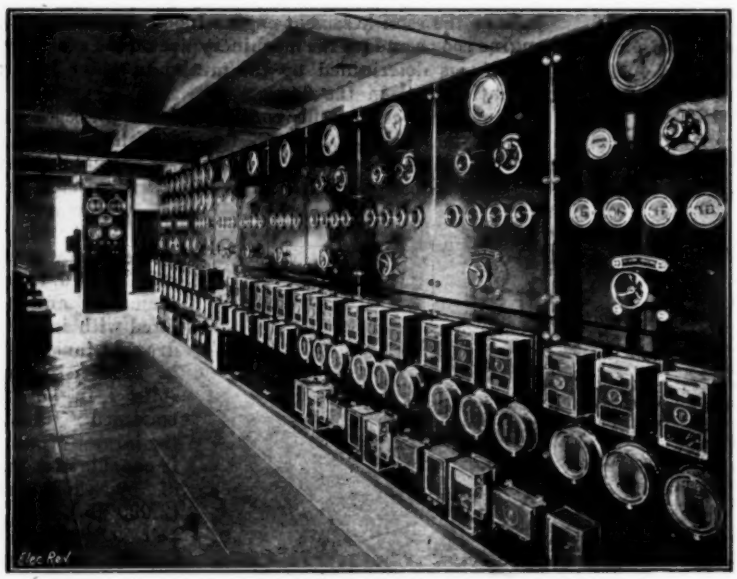


Fig. 4.—6,600-V Cubicle Board.

The first or main throttle valve, which is housed in a separate steam chest, enables the machine to carry ¾ load. The other two carry full load and 5/4 load respectively, and are arranged together in a second steam chest. The steam from the chests enters the steam belt in the high-pressure casing, where expansion nozzles are fixed in the bottom half only. The steam belt of the bottom half casing is closed at the horizontal joint, so that none of the joints, which have periodically to be broken for inspection purposes, are subject to live steam pressure. Worthington-Simpson condensers, fig. 3, are installed, each with a cooling surface of 6,000 sq. ft. The circulating pumps are driven by "Witton" motors, each of which is started by an auto-transformer starter, an oil circuit breaker being also provided for the main control.

The alternators are of the G.E.C. standard type generating at 3-phase, 50 cycles, 6,600 V, and were designed for an 80 per cent. power factor. The ventilation of these machines is such that the air which cools the rotor is kept apart from that which cools the stator during their passage through the machine.

The switchgear, also supplied by the G.E.C., Ltd., is divided into three main sections, a 6,600-V stonework cubicle board, fig. 4, with electrically-operated oil circuit breakers; a steel-plate, slate-front, cubicle board for the 500-V supply for the auxiliaries and lighting; and the auto-transformer starting panels for the auxiliary motors. The control board for the h.p. gear, equipped with the usual modern apparatus, including protective relays, is on a gallery overlooking the engine room, while the steel-plate cubicle board is immediately below. The stonework cells for the oil circuit breakers, links, and instrument transformers are in a room immediately behind the 500-V board and on the same level. The bus-bar cells are situated behind the control board. Three main generator cubicles, one containing a bus-bar coupler, two works cubicles, and three 2,200-kVA feeder panels, accommodate the h.p. switchgear. A duplicate bus-bar system with duplicate links is installed, both sets of links being mounted on the oil circuit breaker side of the cubicle so as to facilitate inspection. The circuit breakers have a maximum breaking capacity of 125,000 kVA, and each phase contact is contained in a separate tank, having a rupturing speed of at least 5 ft. per sec. A coloured-light indicator shows the position of each breaker, "on" or "off." The 500-V board consists of ten panels in all, seven of which control the works supply. The remaining three are a 50-kVA lighting panel; a 50-kVA panel for a charging set; and a busbar disconnecting panel.

It is interesting to note that at the old generating station there is an electrically-operated stonework cubicle system, which is a duplicate of that at the new power house, except that there are four feeder panels, a busbar panel, and five panels for controlling the high-pressure side of the motor-converters. Also in the eight other municipal sub-stations there are installed G.E.C. truck-type cubicle switchboards for the high-pressure circuits, comprising in all some 30 trucks.

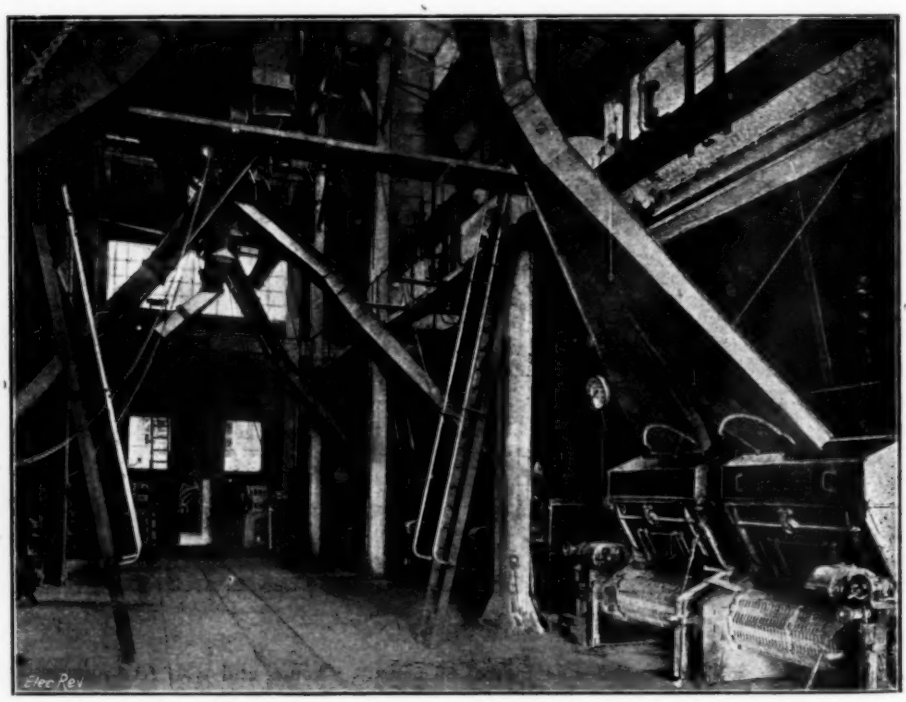


Fig. 5.—The Boiler House.

In the main power house there is installed a petrol engine coupled by belt to a combination machine, which

can be used for battery charging or reversed to supply a.c., while in the event of a shut-down it provides a means for starting the auxiliary motors.

The present output of the station is approximately 1,250,000 kWh per month; the maximum load amounts to 4,050 kW; and the load factor is about 40 per cent. Underground cables transmit the energy to the old power station. Two pairs of cables form a ring main to supply a.c. energy at various points of the western end of the city, while a third cable forms a diameter to the ring and runs direct to the old station. The eastern end of the city is supplied by a second ring from the Schoeman Street station.

The total cost of the station was £250,000, exclusive of the dam and the site. This gives a figure of £25 per kW, of which 10 per cent. was absorbed by transport costs. A further £75,000 was spent on the converter station and mains. These costs are based on 1921 prices. As an indication of the wide use made of electricity in Pretoria, the consumption per head of the white population is about 300 kWh per annum.

Agricultural Electrical Machinery.

Some Features of the Paris Agricultural Exhibition.

By R. BORLASE MATTHEWS, Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

THIS annual Paris exhibition of agricultural machinery increases in size each year and affords a most interesting illustration of the machinery employed by the French farmer, much of which is radically different in detail from that utilised in England. This year the machinery shown in operation was worked by electric motors, and naturally the stands were electrically lighted. The electric motor in itself is no longer considered to be a novelty, but rather an accepted feature of such an exhibition, and owing to its compactness, it is incorporated as an almost obscure part of many machines. French agricultural electric motors are nearly all of the industrial type, for unlike the special farm motors in use in Germany and Scandinavia, no pains seem to be taken to make them dust-proof. While many of the machines are directly driven with individual motors, there is apparently a very large demand for portable motors mounted on wheeled barrows of various styles. These barrows, without exception, are equipped with a countershaft fitted with several pulleys of different diameters, and the endless belt, connecting the motor to this countershaft, is maintained at the proper tension by a counterweighted jockey pulley. The use of such a pulley also ensures a longer surface of belt contact. The motor starter and a drum for the flexible cable are mounted on the same barrow.

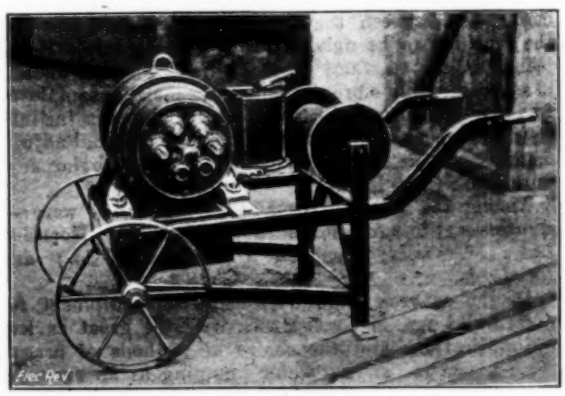


Fig. 1.—The "Law" Motor.

Progress has been made with self-contained geared motors; in fact, in one type, the electric motor has become an accessory which is bolted to the side of the gear box, holes for foundation bolts being provided on the latter. To avoid the trouble of alignment with the various machines that have to be operated, tubular shafts some six or eight feet in length are provided, the ends of which are fitted with Hooke joints; thus the geared motor can be conveniently placed on the floor to drive a machine whose axle is two to three feet above the ground level. Several spindles project from the gear case, fig. 1, each of which is arranged to run at a different speed (say 40, 60, 100, and 200 r.p.m.). The curves (fig. 2) show the advantages of this class of motor, known as the "Law." Figs. 3, 4, and 5 illustrate some of the applications of the machine.

Among the electric thrasher machines, a particularly interesting motor was the Dassenoy, which runs at 3,000 r.p.m.—an unusually high speed for electric-motor drives—and has a sliding armature which facilitates the starting. This method of starting permits the use of a smaller motor than would normally be employed, as it is unnecesary to start on load. Motors of this type are often equipped with a so-called hour meter; really, of course, it is a revolution counter which records the revolutions in units of the hourly number. In this form, the motor is used by French farmers' co-operative societies, and the hire charge to their members is based on the hours indicated on the counter. For these machines the makers claim a better power factor, negligible slip, and a 10 per cent. reduction in consumption for the same work done by motors of the usual type. The motor is also made to run at 1,500, 1,000, and 750 r.p.m.; the standard sizes vary from two to fifteen horsepower.

During recent years, the Ford Motor Co., in order to develop the sales of the Fordson agricultural tractor, have expended a great deal of time and energy in working out various applications of their machine, including farm uses, building operations, and road construction and transport. The manner in which this work has been carried out is a very good object-lesson in the application of the electric motor to farm purposes.

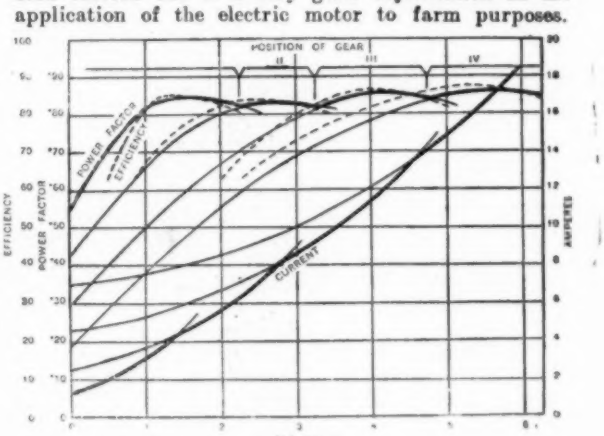


Fig. 2.—Comparison Curves for Geared Motor.

The latest development of Fordson tractor applications is the incorporation of a dynamo. This is accomplished by placing a special cast-steel bracket below and in front of the radiator. The generator is directly connected to the crankshaft at the point where the starting

handle is usually placed. Thus among the numerous duties of the Fordson tractor is now added that of charging the lighting batteries on a farm when required and when the tractor is not employed on other farm work.

On the Continent the mechanical cultivation of vineyards is becoming more and more important, and in this connection a very ingenious plough, somewhat humorously described by the exhibitor as "an intelligent implement," was exhibited. It is provided with a guide in front, which, on coming in contact with any vine stems, momentarily diverts the plough share which follows, thus avoiding any damage to the vine roots. This implement is driven by a Julien & Prat electric motor mounted at the end of a multigear box which gives the choice of special speeds; the final drive is effected by means of an endless belt with a solid cast-iron idler pulley riding upon it to maintain a uniform tension and also to neutralise any shocks, due to stones and such obstacles encountered in the soil which is being ploughed. Though no electric ploughs for ordinary farm work were exhibited, there were several working models; fig. 7 shows an electric plough tractor.

One of the difficulties in operating tractors on the land is that of maintaining a suffioient grip on the soil; almost innumerable types of spuds, strakes, and other non-slipping attachments have been tried, and the latest development is that of the Guerrini "pedorail" chain attachment. This device provides chains which can be mounted over twin rubber tires or pneumatic tires, or else direct on to steel rims. The chain carries a series of eleven feet, mounted on bearings on which the feet can oscillate slightly, enabling two of

Fig. 4.—The "Law" Motor Crushing Corn.

the feet to come in contact with the ground at the same time, thus very greatly improving adhesion, especially on soft ground. While apparently quite satisfactory for slow speeds, such as those of agricultural tractors, the device is not suitable and is too noisy for the higher speeds of lorries, though it is employed by the French War Department for temporary attachment when a lorry has to travel over very rough or very soft soils.

The Renault Motor Co. showed a 20/40-h.p. oil engine driving a 220/127-V, 79-A, 3-phase alternator, running at 1,500 r.p.m., with a 50-V, 20-A exciter. The alternator and exciter were made by the Société Alsacienne de Constructions Mécaniques, Belfort. This type of plant is intended for temporary use in a district pending the construction of overhead supply lines.

The Diluvien automatic watering machine was on view. This consists of a motor-driven pump mounted on a small wagon which progresses automatically. The water is distributed by means of two arms which carry roses at intervals for spraying the water. The apparatus is intended particularly for the use of market gardeners. It will water, it is claimed, a surface of 3,000 to 6,000 sq. yds. per hour and distribute about 7,000 gallons of water during that time. The machine is fitted with a 2½-h.p. motor, and the pump runs on a permanent rail track laid down the centre of the ground that is to be watered. The automatic watering of crops is becoming of more importance, not only to the market gardener but also to the farmer, hence all developments of this nature are well worthy of study.

A new development in self-contained geared motors for the French market is a high-speed motor, 3,000 r.p.m., which follows the lines of some German designs,

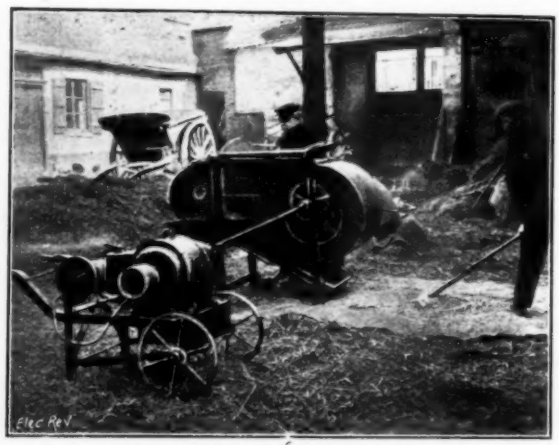


Fig. 3.—Driving a Winnowing Machine.

of one-half to two horse-power. This makes an exceedingly compact machine. It is fitted with a double-reduction gear and drives at one speed only. For the sake of portability a convenient handle is incorporated. A switch is counter-sunk into the motor frame so as to be readily accessible and yet not easily damaged. The connection between the shaft or motor gear box and the machine to be driven incorporates a triple Hooke joint. A tripod stand supports the motor (fig. 6), and it is considerably more stable than the machines employed in other countries, which in practical use are inclined to wobble about. The stability is due to the final adjustment being effected by a sliding vertical tubular support above the tripod.

Among the English firms which exhibited were:—Ransomes, Sims & Jefferies, Ltd.; Ruston & Hornsby, Ltd.; Marshalls; Campbell Gas Engine Co.; and Bamfords.

In the general exhibits of electrical equipment for farm buildings, one was struck with the great variety of applications and the choice of methods of accomplishing each. Taking water pumping as an example, there must have been over forty different designs of pumps on show. The general trend seems to be towards automatic pumps of small horse-power, which provide a high-pressure delivery and yet are of simple design and reasonable cost. The air-pressure tank seems to be falling out of favour, its place being taken by a small cistern, mounted at a considerable height, to provide

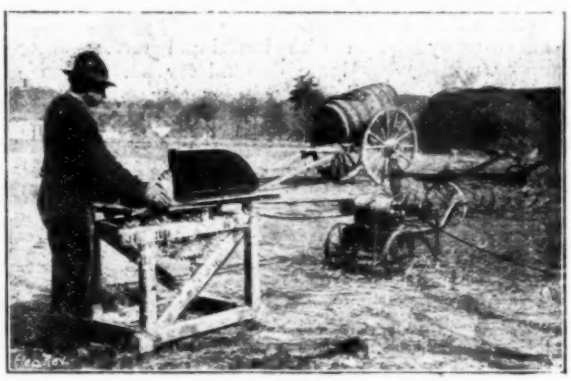


Fig. 5.—Driving a Saw Mill.

the required head. One very good form of float control that was noticed, made by the Société Générale Agricole, consisted of a metal arched tube containing a small quantity of mercury. When the control is operated, by the limits of the change of level of the water, the over-

balancing or spilling of the mercury in the curved tube takes place with less friction than that of a roller weight, hence the switch is operated more positively. There were a great many modern variations of the *chaine hélice* pump on view. In the case of centrifugal pumps, base-plates are often now eliminated; this is accomplished by designing the pump casing as a part of the motor end frame—provision being made for an accessible stuffing box. This makes a very simple, cheap and neat design.

Fig. 6.—Portable Motor on Tripod.

As to washing machines, there are a great many makes from which to choose. The general construction is of such a type that they can be sold at lower prices than those on the British market. Fig. 8 shows a very popular design of this form of machine. It will be observed that galvanised sheet steel is largely used in their construction. One French motor manufacturer is marketing a fractional horse-power electric motor combined with a worm reduction and automatic reversing gear, in one complete unit. This is adaptable for the driving of any horizontal drum type washer. The automatic reversing gear is essential for operating drum-type washers, for the clothes that are being washed would otherwise get too closely pressed or wound together to become properly cleansed.

Several working examples of milking machines were on view. A feature of the Alfa-Laval machines is the use of rubber tubing which has extremely smooth interior surfaces, thus avoiding resting places for deleterious bacteria. A Danish machine—the Dana—now largely used in France, employs a new principle in milking-machine design, for its valves are operated by the milk as it is drawn from the cow. This feature enables the cows to be milked quite dry—an operation which, it is claimed, no other machine accomplishes, it being usually necessary after the milking machines are removed for the cow to be "stripped." Further, the "strippings" contain a big percentage of cream, and also if they are not drawn off properly, the cow diminishes her supply of milk at subsequent milkings. Of course, the vacuum pumps of these milking machines could be operated by oil engines, but in practice the farmers appreciate the self-contained electric unit, as the cow is very sensitive to any change in the regularity of the pulsations, reducing her supply of milk if they are erratic.

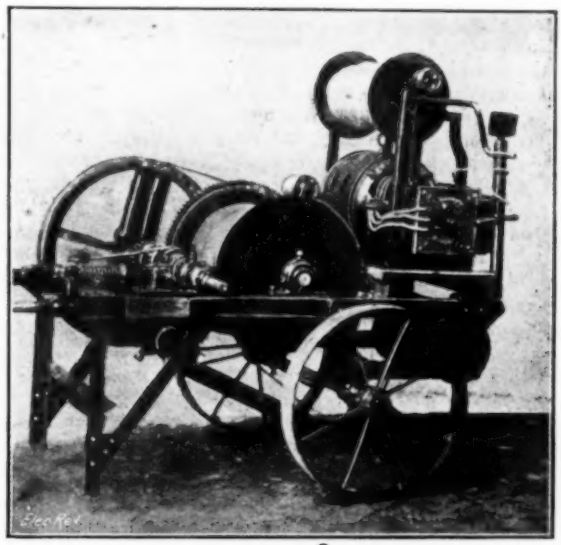


Fig. 7.—Electric Plough Tractor.

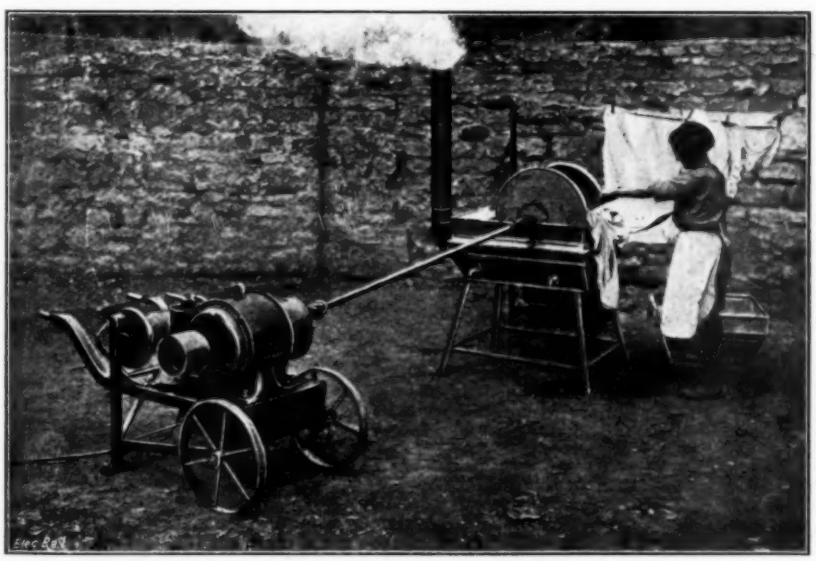


Fig. 8. - Electric Drive for Washing Machine.

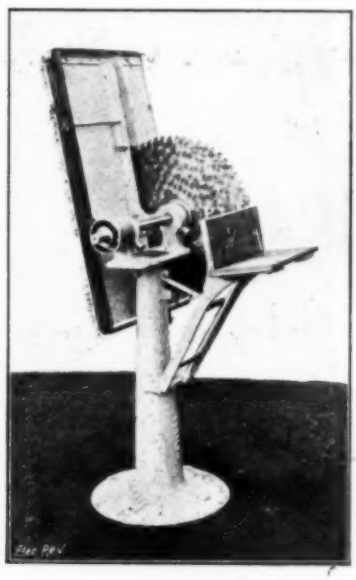


Fig. 9.—Tilting-Table Machine.

An important problem on every farm is the transport of material. On the Continent and in America to-day there is a marked tendency to install overhead transporters of various kinds, and in modern British cow houses the overhead runway is becoming familiar; but the electrically-operated transporter gear is almost unknown here. Several examples of these were on view at the exhibition. They might be briefly described as simple modifications of the well-known Temperley coal transporters, adapted to agricultural conditions and farm limitations of capital costs.

On every farm, a circular saw is a most convenient tool. In France it has developed in a most useful way, many of the machines being adapted to serve for both log and firewood, and also for ordinary odd-job work. This is accomplished by the aid of a tilting table or bascule, fig. 9. There can be no doubt that firewood sawing is made much safer when the wood is firmly supported in double Y-arms, as is done in these double-purpose machines.

Electrically-driven cross-cut log saws have been on the market for some time, and have proved their utility. A new development which was shown at Paris is an electric portable horizontal saw, made by the Société Générale Agricole, for cutting down standing trees. As the result of practical experience, the circular saws used for this purpose are made with four sets of three special teeth. The first two of each set are clearing points of semi-circular shape, while the third is of the usual shape. This same tool can also be used for other circular-saw work when a circular saw of the normal type is substituted, for the power transmission is through two different bevel drives, and that the gear-box casings are arranged for turning at any convenient angle to suit the work in hand.

It will be appreciated from the foregoing remarks that steady progress is being made in the development of new electrically-operated apparatus for the farmer and rural dweller in France. Continental farm labourers are not as a rule so intelligent as the British farm hands, and when electrical distribution in this country reaches the stage it now occupies in many parts of the Continent, we may anticipate an extended use of even more ingenious labour-aiding (a preferred expression to labour-saving) machinery, over the country-side.

Three-Phase Four-Wire Metering.

Comparative Performances of Four Types of Equipment.

By GEO. D. MALCOLM.

In my previous article on the metering of three-phase power,* I confined my remarks to three-wire industrial practice, and endeavoured to prove that the three-wire unbalanced-load meter was the most satisfactory medium for that purpose. The metering of a 3-phase 4-wire supply, which may include under one service 3-phase motors, single-phase motors, and perhaps heating—if the tariff permits—is, however, quite another proposition, and requires a different solution.

Supply authorities generally insist on large lighting installations being separated, and the load more or less equally balanced between the three phases; so once again the question of how best to deal with this form of supply is presented.

One, or even two, of the phases may be temporarily disconnected for some reason or other; one single-phase motor, one radiator, or one small section of lighting may constitute the total load at some period; one 3-phase motor may be in commision alone; a considerable amount of "out-of-balance" may be caused by groups of single-phase units being on load simultaneously; and so on. The combinations of possible conditions are many, and the metering equipment installed should be capable of integrating accurately under all of them.

*Electrical Review, October 30th, 1925, p. 689.

There are two methods which may be employed, *viz.*:—

(1) Three single-phase meters.

(2) One 3-phase 4-wire unbalanced load meter.

The latter method may be again sub-divided into:—

(1) 3-phase 4-wire two element type meter;

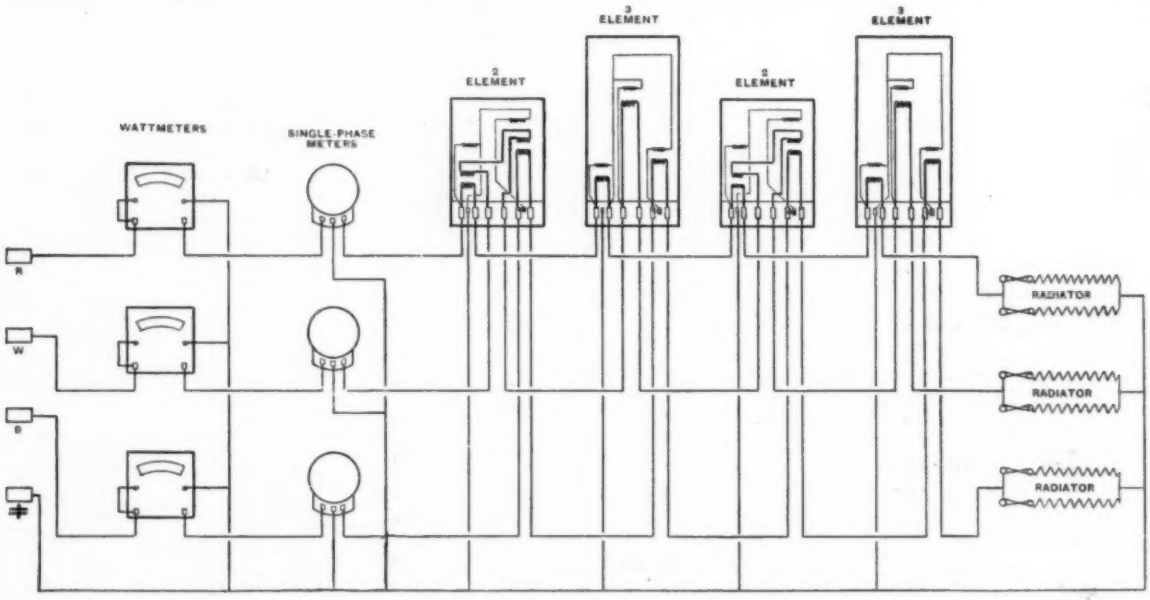
(2) 3-phase 4-wire three element type meter (2 rotors);

(3) 3-phase 4-wire three element type meter (3 rotors);

and it is the relative performances of these three types of polyphase meters which present the most interesting features.

Opinions still differ on this point; and whilst some manufacturers state that the 2-element type meter will cope with all conditions likely to arise, others hold that the 3-element, 3-rotor type meter is the only correct type for the task. The experience of supply engineers who have been called upon to deal with this class of supply also seems to vary, and it is hoped, therefore, that the results of tests recently made will be of passing interest to both groups.

Comparisons were made to ascertain which of the following four systems of metering would produce the most accurate record of the consumption on non-inductive and inductive 3-phase 4-wire installations, under normal and abnormal conditions, the equipments employed being:—



System No. 1.—Three single-phase meters.

System No. 2.—One 3-phase 4-wire 2-element polyphase meter.

System No. 3.—One 3-phase 4-wire 3-element polyphase meter (2 rotors).

System No. 4.—One 3-phase 4-wire 3-element polyphase meter (3 rotors).

The tests were carried out "on circuit" under practical service conditions, the meters having been carefully checked in the test room before being installed.

As in the previous series of tests, three 2-element radiators, each controlled by two switches, were utilised to provide the non-inductive loads; but in this case one terminal of each radiator was connected to the neutral of the system, as shown in fig. 1. Various combinations of circuits and irregularities were reproduced, and tests taken on all meters under each condition. The results obtained, reduced to a percentage basis to facilitate comparison, are set out in Table I, column 2 of which indicates the state of balance existing at the time of each test.

TABLE I.

Units chargeable in respect of 3-phase, 4-wire, non-inductive load under four systems of metering.

System No. 1.—Three single-phase meters.
System No. 2.—One 3-phase, 4-wire, 2-element polyphase meter.
System No. 3.—One 3-phase, 4-wire, 3-element polyphase meter (2 rotors).
System No. 4.—One 3-phase, 4-wire, 3-element polyphase meter (3 rotors).

Condition of Load.	Radiator Elements. B.	W.	R.	True Units.	System No. 1.	2.	3.	4.
Full	2	2	2	100	102	99	99	100
Half	1	1	1	,,	101	99	101	100
Blue phase, light ...	1	2	2	,,	101	96	99	101
White ,, ,, ...	2	1	2	,,	102	98	100	102
Red ,, ,, ...	2	2	1	,,	101	98	99	101
Blue phase, heavy ...	2	1	1	,,	102	97	99	102
White ,, ,, ...	1	2	1	,,	102	99	100	100
Red ,, ,, ...	1	1	2	,,	100	98	100	100
Blue switches, open ...	–	2	2	,,	101	99	101	101
White ,, ,, ...	2	–	2	,,	101	97	100	101
Red ,, ,, ...	2	2	–	,,	100	99	100	101
Blue fuse, drawn ...	–	2	2	,,	102	76	103	102
White ,, ,, ...	2	–	2	,,	102	97	105	102
Red ,, ,, ...	2	2	–	,,	100	77	103	101
B. & W. ,, ,, ...	–	–	2	,,	102	98	105	102
W. & R. ,, ,, ...	2	–	–	,,	100	98	104	102
R. & B. ,, ,, ...	–	2	–	,,	102	—	107	103
Neutral ,, ,, ...	2	2	2	,,	102	96	99	102

For the purpose of the inductive series of tests, the radiators were replaced by three choke coils. The figures tabulated in Table II represent, therefore, what might be expected—at some time or another—under industrial conditions, and provide data upon which the choice of the most reliable and straightforward system of metering may be based.

TABLE II.

Units chargeable in respect of 3-phase, 4-wire, inductive load under four systems of metering as in Table I.

Condition of Load.	Choke Coils. B.	W.	R.	True Units.	System No. 1.	2.	3.	4.
3 single-phase units ...	1	1	1	100	100	99	90	100
Blue phase unit, alone	1	–	–	,,	100	97	100	100
White ,, ,, ,,	–	1	–	,,	100	100	102	101
Red ,, ,, ,,	–	–	1	,,	100	97	100	101
Blue phase fuse, drawn	–	1	1	,,	100	106	103	102
White ,, ,, ,,	1	–	1	,,	101	97	101	101
Red ,, ,, ,,	1	1	–	,,	100	46	103	101
B. & W. ,, ,, ,,	–	–	1	,,	101	100	104	102
W. & R. ,, ,, ,,	1	–	–	,,	100	98	104	100
R. & B. ,, ,, ,,	–	1	–	,,	100	—	107	103
Neutral fuse, drawn ...	1	1	1	,,	99	95	98	101

It will be noted that Systems Nos. 1 and 4 integrate accurately under all the conditions produced. The 3-element, 2-rotor meter in System No. 3 tends to speed up during periods of partial disconnection from the mains, due, no doubt, to the elimination of "interference" factors which are present under normal conditions. System No. 2, employing the 2-element polyphase meter, proved most unreliable under certain circumstances. When the red phase or blue phase fuses are "blown" or withdrawn, a very definite source of error is introduced, due to there being only one of the two shunt coils energised at the time. As this coil interacts with the half of the white phase current coil overwound on that particular element, the resultant torque—and in consequence the registration—is affected correspondingly. Under non-inductive conditions, the meter registers only 50 per cent. of the consumption in the white phase circuit. When the power factor of the circuit is below unity, the average error with the blue or red phase fuses withdrawn is 50 per cent., the ratio between the two errors depending on the power factor. It will be noted that with the blue phase fuse withdrawn, the accuracy of the meter improves as the power factor decreases. The reverse effect is produced when the red phase main is disconnected. When both red and blue phase fuses are withdrawn, no registration is recorded in respect of any consumption in the white phase circuit; and although this may appear to be a remote probability, the possibility is one that should not be ignored, even if the duration of the disconnection is short. The chance of one fuse being "blown" or withdrawn is certainly greater, and the possibility of such a large error in the registration of the white phase consumption when this occurs is worthy of consideration when contemplating the adoption of this type of meter. As it is difficult—if not impossible—to ensure that the condition $e1 + e2 + e3 = 0$ is maintained at all times, it is, therefore, impossible to guarantee, or to expect, complete accuracy under all circumstances. Add to this the possibility of either $e1$ or $e3$—or both—being unavailable at the meter terminals, and faith in the reliability of the 2-element meter is seriously undermined.

It has already been shown that the use of three single-phase meters is not entirely satisfactory when dealing with an industrial three-phase power supply, owing to the unbalanced readings obtained, and to the occasional meter reversals which are the cause of so much investigation and frequent dissatisfaction. It would, therefore, appear reasonable to assume that, when both 3-phase and single-phase motors are connected to a 3-phase 4-wire circuit, the choice should lie between Systems Nos. 2, 3 and 4. The 2-element meter has been shown to possess inherent weak points, which become manifest under certain conditions, and we are, therefore, left with the 3-element polyphase meter as the only "error-proof" meter to adopt for this class of load.

For non-inductive loads, Systems Nos. 1 and 4 are equally satisfactory as far as performance is concerned. I would, however, in conclusion, quote an analogy to point a moral. One buys an adding-machine as a step towards increased efficiency, and as a time and labour-saving device. After manipulation, a final total is expected, and is recorded. It is not necessary to add up, say, three independent results to get that total; it is done automatically and accurately by the machine. What a wonderful "adding-machine" the polyphase meter is, accomplishing, as it does, even algebraical sums when occasion arises, and recording the net result on one dial.

An Enlarged Mollier Diagram.—A Mollier diagram on a large scale, plotted by Prof. H. L. Callendar, F.R.S., from his enlarged steam tables, has been published by Messrs. Edward Arnold & Co. for the British Electrical and Allied Industries Research Association. The diagram, which was prepared for the Turbine Section of the Beama, relates to saturated and superheated steam, and measures 660 × 800 mm.; it is admirably printed in three colours, and is very clearly figured, while the scale is so large that a high degree of accuracy is attainable—one millimetre representing 0.001 ϕ and 1.0 B.th.u. per lb. The ranges covered are from 0.2 to 2,000 lb. per sq. in. absolute pressure, 0 to 500 degrees F. superheat, 0.3 to 1,000 cu. ft. per lb., 100 to 1,000 degrees F., 65 to 100 per cent. dryness, and 26 to 29.6 in. vacuum. The corresponding range of entropy is from 1.36 to 2.02, and of total heat per lb. from 700 to 1,500 B.th.u.

The diagram, which is priced at 4s. net, is a very fine production, and will be very useful to engineers concerned with $H-\phi$ calculations.

Electricity Supply in Great Britain.—XIV.

Cumberland, Westmorland, Lancashire, and Cheshire.

With reference to the accompanying maps, which have been hatched to show the areas occupied and applied-for in respect of statutory powers for general supplies of electricity, it has been found convenient to include the north-west portion of Lancashire with the map of Cumberland and Westmorland. Space will not permit of the map of Cheshire being reproduced, but it is available if required. Prints on art paper of the maps which have appeared in this series, and coloured maps, 4 miles to one inch, are also available.

The 1921 Census gives the following figures for the Administrative Counties and County Boroughs:—

Electricity Supply in Cumberland and Westmorland.

	Acres.	Persons.	Resident families.	Buildings, not containing dwellings.
Cumberland ...	973,086	273,173	59,579	4,214
Westmorland ...	504,917	65,746	14,648	1,897
Lancashire ...	1,194,555	4,927,484	1,108,668	68,300
Cheshire ...	657,950	1,025,724	236,427	12,454
Total ...	3,330,508	6,292,127	1,419,322	86,865

The total number of kWh generated in the above counties has been ascertained by the addition of the outputs of Areas Nos. 2, 3, 5 13, and 17 (as given in Table 8 of the Electricity Commissioners' publication, "Generation of Electricity in Great Britain"), except that Chester and Crewe are excluded and Buxton and Glossop included.

Table No. 1 of this publication gives the description of these Areas as follows:—

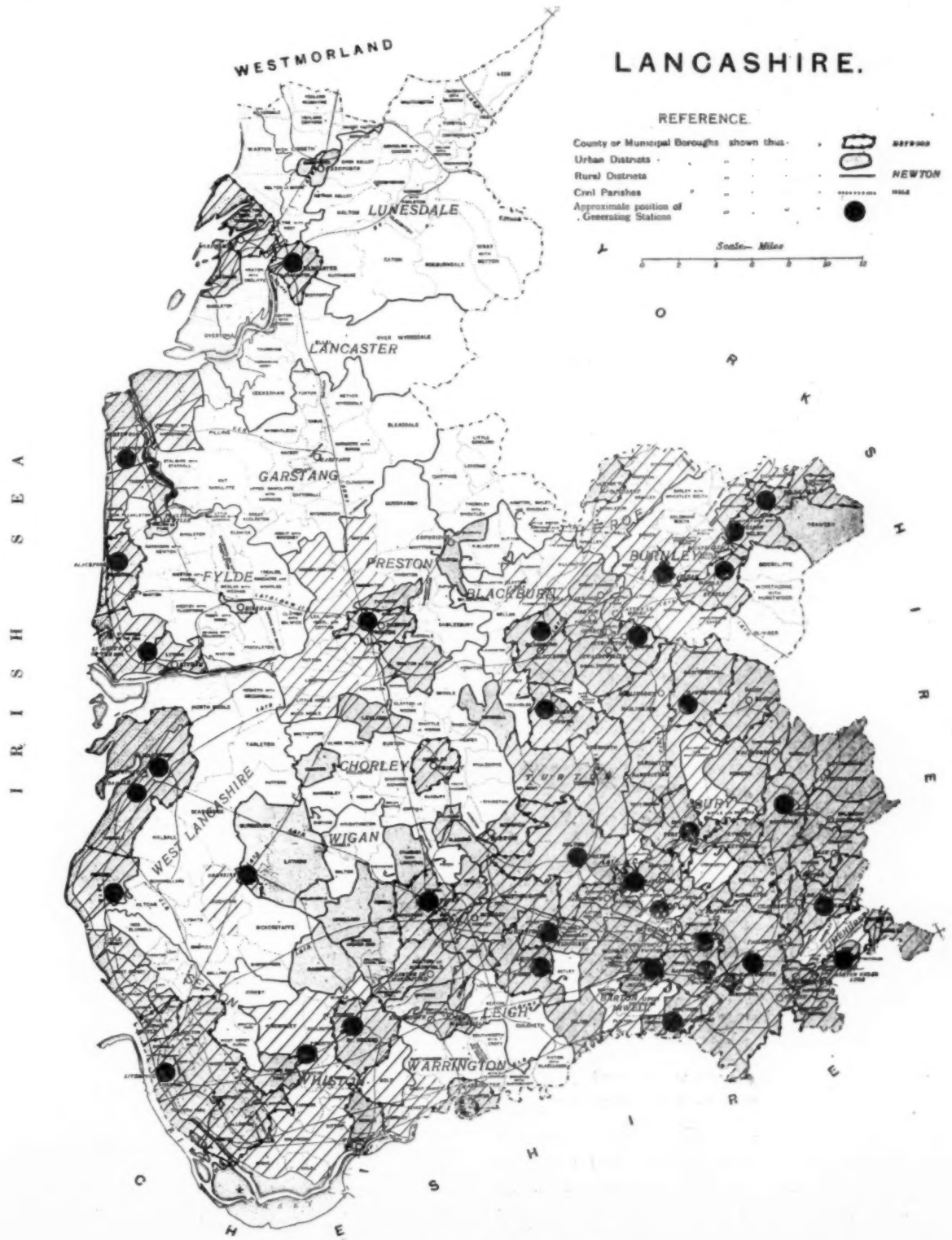
Area No. 2.—The Mid-Lancashire Electricity District as finally determined.

Area No. 3.—The South-East Lancashire Electricity District as finally determined.

Area No. 5.—The Mersey and West Lancashire Electricity District as provisionally determined and amended.

Area No. 13.—The North Lancashire and South Cumberland Electricity District as provisionally determined.

Area No. 17.—The parts of the Counties of Cumberland and Westmorland not included in Area No. 13.



Electricity Supply in the County of Lancashire.

KILOWATT-HOURS GENERATED.

Year ending March 31.	Area No. 2.	Area No. 3.	Area No. 5.	Area No. 13.	Area No. 17.	Total of Areas Nos. 2,3,5, 13 & 17
1922	66,209,448	536,232,207	231,943,138	12,503,161	9,067,355	855,954,309
1923	82,413,644	647,284,355	280,552,537	13,263,085	10,737,169	1,034,250,790
1924	93,290,029	741,676,970	340,538,427	15,436,055	12,675,131	1,203,636,215
1925	109,705,708	838,793,940	387,510,032	19,607,893	13,626,560	1,369,243,533

The following is the list of existing authorised undertakers:—

Local Authorities.

Area No.		Area No.	
2	*Accrington Corp.	3	Littleborough U.D.C.
3	Ashton-in-Makerfield U.D.C.	5	*Liverpool Corp.
3	*Ashton-under-Lyne Corp.	2	*Lytham-St. Anne's Corp.
3	Atherton U.D.C.	3	*Manchester Corp.
2	Bacup Corporation	3	Middleton Corp.
13	*Barrow-in-Furness Corp.	3	Milnrow U.D.C.
5	*Birkenhead Corp.	13	Morecambe Corp.
2	*Blackburn Corp.	2	*Nelson Corp.
2	*Blackpool Corp.	5	Newton-in-Makerfield U.D.C.
3	*Bolton Corporation	3	*Oldham Corporation
3	Bredbury & Romiley U.D.C.	2	Padiham U.D.C.
2	Brierfield U.D.C.	2	Preesall U.D.C.
2	*Burnley Corporation	2	*Preston Corporation
3	*Bury Corporation	3	Radcliffe U.D.C.
17	*Carlisle Corporation	2	*Rawtenstall Corp.
3	Cheadle & Gatley U.D.C.	3	*Rochdale Corp.
—	*Chester Corporation	5	*St. Helens Corp.
2	Clitheroe Corp.	3	Sale U.D.C.
2	*Colne Corporation	3	*Salford Corporation
—	*Crewe Corporation	5	*Southport Corporation
2	*Darwen Corporation	3	*Stalybridge, &c., Elec. Board
3	*Eccles Corporation	3	*Stockport Corp.
3	Farnworth U.D.C.	3	*Stretford U.D.C.
2	*Fleetwood U.D.C.	3	Swinton & Pendlebury U.D.C.
5	Formby U.D.C.	2	Thornton U.D.C.
13	Grange U.D.C.	3	Turton U.D.C.
2	Haslingden Corp.	13	Ulverston U.D.C.
3	Hazel Grove & Bramhall U.D.C.	5	*Wallasey Corporation
3	Heywood Corp.	5	*Warrington Corp.
3	Hindley U.D.C.	5	Whiston R.D.C.
3	Horwich U.D.C.	17	*Whitehaven Corp.
5	*Hoylake & West Kirby U.D.C.	17	Whitehaven R.D.C.
3	Irlam U.D.C.	3	Whitworth U.D.C.
13	*Kendal Corporation	3	*Wigan Corporation
13	*Lancaster Corp.	5	Wirral R.D.C.
3	*Leigh Corporation	17	Workington Corp.

*Local Authority Undertakers owning generating stations.

Area No.	Companies.
3	Alderley & Wilmslow Electric Supply, Ltd.
3	Altrincham Electric Supply, Ltd.
5	Birkdale District Electric Supply Co., Ltd.
5	British Insulated Cables, Ltd.
5	Caldy Manor Estate, Ltd.
5	Castner Kellner Alkali Co., Ltd.
17	Cumberland Waste Heat Owners Co., Ltd.
3	Electricity Company of Macclesfield, Ltd.
5	Hightown Gas & Electricity Co.
17	Keswick Electric Light Co., Ltd.
2 & 3	Lancashire Electric Power Company.
5	Mersey Power Co., Ltd.
5	Northwich Electric Supply Co., Ltd.
5	Ormskirk Electric Supply Co., Ltd.
5	Ormskirk Gas & Electricity Co.
17	Penrith Electric Supply Co., Ltd.
13	Windermere & District Electric Supply Co., Ltd.

All the above Companies possess generating stations, except the Hightown Gas & Electricity Co., which takes a bulk supply from the L.M.S. Rly., and the Ormskirk Gas & Electricity Co., which has not yet commenced supply.

The area of the Lancashire Electric Power Company has not been hatched, except where statutory powers for general supplies are held or have been applied for. This Power Company has various powers over that part of Lancashire which lies south of the River Ribble, except for certain County Boroughs, and it also holds 18 distribution Orders. The Power Company's generating stations at Radcliffe and Padiham have been indicated on the map. Separate dots have been shown for Manchester Corporation's stations at Barton and Stuart Street, and also for Salford Corporation's stations at Agecroft and Frederick Road.

The generating stations of the London, Midland and Scottish Railway at Clifton and Formby, and that of the South Lancashire Tramways Company at Atherton, have also been indicated on the map.

Applications for Special Orders have been lodged by the following:—

Lancashire Electric Power Company.
Gwynedd Trust, Ltd.
Chester Corporation (Extension).
Millom Urban District Council.
Barton-upon-Irwell Rural District Council and Urmston Urban District Council jointly.

These maps are reproduced by permission of the Controller of H.M. Stationery Office.

The originals were prepared by the Ordnance Survey Department for the 1917 Boundary Commission. Since 1917 many alterations to areas, &c., have been made, of which particulars are available if required.

The Fine Regulation of Resistance.

Some Particulars of the Multi-Step Rheostat.

By R. AMBERTON, M.I.E.E.

The problem of fine regulation over a considerable range of resistance is an old one. There is not much difficulty if the current to be carried is infinitesimal, or if it is permissible to employ a rheostat with coarse steps of relatively high-resistance values, and subsequently to make the final adjustment on one or more separate finely-graded rheostats having a relatively low resistance. This method is the usual one when the final resistance value to be obtained is the only consideration, but it is of no use when it is essential that fine regulation is available throughout the range, and when the "kick" or "jump" caused by moving the coarse rheostat a step backwards or forwards defeats the object of the combination.

The regulation of the exciter fields of alternators and motor converters is a case where smooth regulation over a fairly wide range of resistance is necessary, although, of course, there are many other applications. The employment of separate coarse and fine rheostats being in many cases ruled out on account of the resultant "kick" when the arm of the coarse rheostat is moved, the usual practice is to use an ordinary single-arm rheostat with a large number of steps. This rheostat is graded as carefully as possible, so as to ensure the most satisfactory results at the most critical points. Theoretically, of course, there is no reason why this method should not prove perfectly satisfactory, but there are certain practical difficulties which limit its scope.

If space and cost were of no consequence, it would be possible to imagine a rheostat with a faceplate large enough to have, say, 400 contacts. This would be ample for practically all requirements, but it would involve the use of a faceplate over six feet square. Quite apart from the cost, which would be prohibitive, it is not often that this amount of space is available.

With a more modest rheostat, having between 100 and 200 steps, the faceplate can be kept within a reasonable space, but the difficulty which the rheostat maker has to face is that of making such a large number of satisfactory insulated connections from the contacts of the rheostat to the resistance elements. If the size of the rheostat and its resistance is to be kept within the compass demanded by cost and switchboard space, it must necessarily be run at a reasonably high temperature; and there is only a limited choice of commercial insulated wires which will retain their insulating properties over a period of years when subjected to heat and friction due to expansion and contraction when the connections are bunched up with a couple of hundred of their fellows.

The makers of exciter field rheostats and the manufacturers of dynamo-electric machinery are aware of the difficulties, and take them into account. The result is a compromise, and whilst the rheostat maker has on

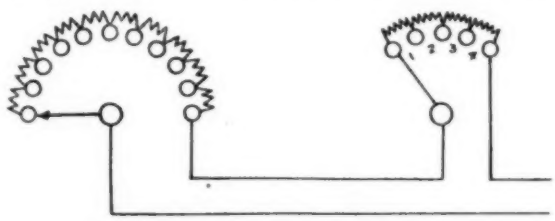


Fig. 1.—Fine and Coarse Rheostats in Series.

occasion to supply exciter field regulators with rather more steps than is quite convenient, the designer of the machine has to put up with rather fewer than he would like. From time to time attempts have been made to solve the problem, and the most popular method has been the combination of coarse and fine rheostats operated by a single hand-wheel. One of these was described on page 673 of the ELECTRICAL REVIEW, published on May 7th, 1915.

In view of the fact that previous attempts have been made to combine two rheostats to obtain even regulation over a wide range, it is as well to point out why they have hitherto not fully achieved their object. Fig. 1 shows a coarse rheostat in series with a fine one. Assuming that the whole of the resistance of the fine rheostat is equal to one step of the coarse rheostat, it is obvious that the total number of resistance values which can be obtained with the combination, is the product of the number of steps of fine and coarse. It is equally true, but not quite so obvious, that with the electrical connections as shown it is absolutely impossible to avoid a "kick" when the coarse rheostat is moved from one step to another. This difficulty remains and must remain, whatever forms the rheostats take, or whatever the mechanical arrangements may be, so long as the electrical connection between the two rheostats is

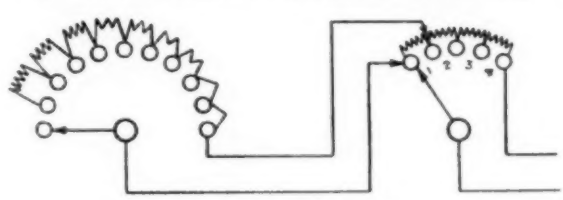


Fig. 2.—Principle of the Multi-Step Rheostat.

in effect a series connection. It is curious that this point should have been consistently overlooked, but the fact remains.

The solution is quite simple, as will be seen from fig. 2, and it is on these lines that the multi-step rheostat (Patent No. 212,089) is constructed. It is clear that without moving the arm of the coarse rheostat it is possible to cut out its first step by means of a left to right movement of the fine rheostat, and, if the resistance of the latter is suitably graded, resistance will be cut out in equal increments.

Having short-circuited the first coarse step in gradual stages by means of the fine regulator, the arm of the coarse rheostat can be moved forward one step, thus taking up the short circuit and enabling the fine rheostat to be disconnected from the coarse one without electrical change. The arm of the fine rheostat is now returned to the "off" position, and its terminals are connected to bridge the second step of the coarse rheostat ready to cut out this step in a manner similar to the first. After cutting out the second step by gradual stages the cycle of operations can be continued until all the resistance is cut out. Similarly, by reversing the procedure the whole of the coarse resistance can be put in by equal increments.

It now remains to be shown how these somewhat cumbersome operations can be translated and co-ordinated into a practical method of combining a coarse and a fine rheostat so that the whole of the resistance of the former is cut out in equal fine gradations and without "kicks" by means of a unidirectional movement of one hand-wheel. To do this it is necessary to introduce a third rheostat, or rather a third set of contacts interconnected with the coarse and fine rheostats in such a manner as to facilitate the changes of connections which are necessary after cutting out one step, and before starting to cut out the next.

In the diagram (fig. 3) the essential parts are; the main rheostat with its insulated brush A, the auxiliary rheostat with its insulated brush B, and the fine rheostat with its insulated brush C. Brushes A and B are carried on a common arm (afterwards referred to as the main arm) and move in unison. Brush C is carried on a separate arm (which will be referred to as the short arm) intermittently coupled to the main arm in such a manner

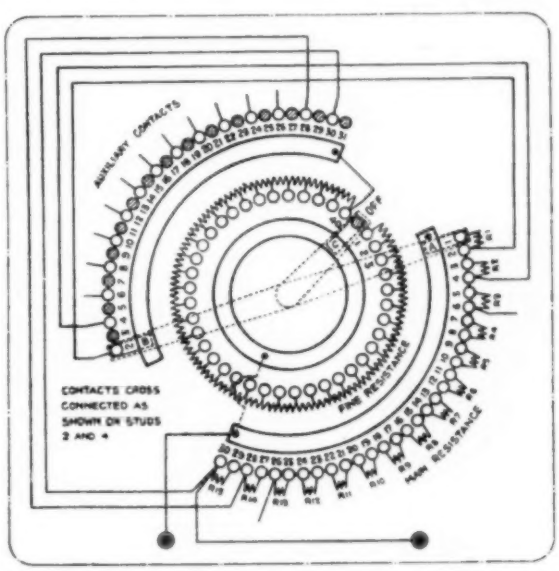


Fig. 3.—Multi-Step Rheostat: Diagram of Connections.

that for each complete revolution of the short arm the main arm moves over one section of resistance, *i.e.*, from one dotted line to the next.

Brush C is shown on its "off" position, and if the diagram is studied it will be found that if it is moved in a clockwise direction on to its first contact, the total resistance of the fine rheostat is in parallel with R1, the first step of the main resistance. Continuing the clockwise movement, the resistance is gradually cut out until when the fine rheostat reaches its "full on" position, all its resistance is cut out and the first step of the main resistance is short-circuited. At this point the gearing between the short and the main arms comes into mesh, and the following changes of connections occur:—

1.—Brush A moves forward one contact (to stud 2), thereby taking up the short circuit of the first coarse step (R1) which C established. Brush B moves forward one contact on to a shaded stud, thereby disconnecting itself, since the shaded studs are not connected to anything. Brush C moves on to its "off" position. These movements are all simultaneous.

N.B.—Various connections have been changed, but there is no change of electrical resistance.

D

2.—The movement being continued, brush A moves forward one contact to stud 3 which, however, being directly connected to stud 2, which it has just left, causes no electrical change. Brush B moves forward one contact to stud 4, and is now connected to the remote side of R2, the second main step of resistance. This movement by itself does not effect any change of resistance, but as soon as brush C (which is moving simultaneously) reaches its No. 1 contact, the whole of the fine resistance is in parallel with R2, the second step of the main resistance. Just before this stage is reached the mechanical gearing between the short and the main arms comes out of mesh, so that a continued clock-wise movement of C will cut out R2 in gradual stages, just as R1 was previously cut out.

By continuing the movement R3, R4, R5 and all the rest of the main steps are successively cut out by equal increments, and a reversal of the movement at any stage

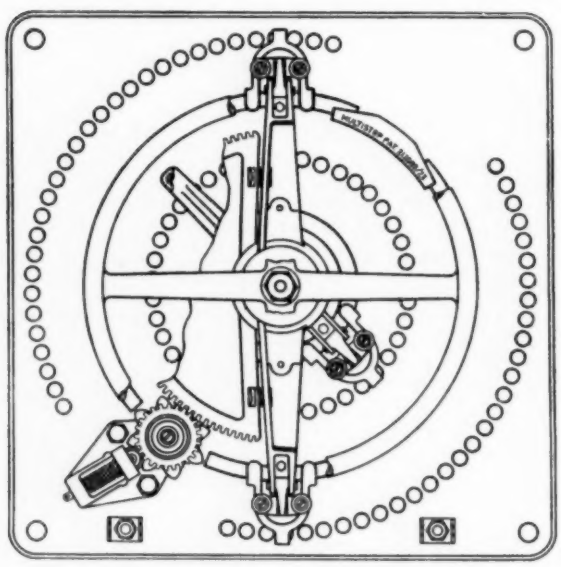


Fig. 4.—General Arrangement of Rheostat.

will cut in resistance in a similar way. Fig. 4 is a drawing of the complete rheostat. The functions of the arms have already been explained, so that it only remains to describe the mechanical arrangement. The operating hand-wheel is directly coupled to the main spindle of the rheostat. The short arm is pinned to the main spindle, and rotates with it. The main arm is loose on the spindle, and friction is reduced by ball bearings, as the main arm has to remain stationary during the bulk of the movement of the spindle. It is important that the relative positions of the two levers should always be correct during their period of engagement. To ensure this a ram has been included, bearing on the blunt-toothed driving wheel, which thus also acts as a star wheel.

The short arm carries a striking pin with roller on its tail piece. Once in every revolution it engages with the blunt-toothed star wheel and moves it round one notch. This blunt-toothed wheel carries a small pinion which engages with the semi-circular rack carried by the main arm, so that during the period of engagement between the striking pin on the short arm and the star wheel, the main arm (carrying brushes A and B) moves correspondingly.

It is obvious that by increasing or decreasing the size of the rheostat a larger or smaller number of steps can be provided. The illustration shows a standard multi-step rheostat with 15 sections of coarse resistance, and 40 sections of fine, thus giving 600 effective steps without "kicks" and by means of a unidirectional movement. As a maximum, 55 connections are required from the two sets of studs to their respective resistances. In practice, a smaller number of insulated connections is required as a rule, as at one end of the fine rheostat, the resistance values are generally so low as to enable the requisite resistance to be obtained by means of short lengths of rigid self-supporting resistance wire directly connected to the studs.

To move the main arm from the "all in" to the "all out" position fifteen revolutions of the hand-wheel are requirevd. If it were ever necessary to move the main rheostat arm rapidly from one end to the other this could be quite easily provided for by the addition of means for directly engaging the small pinion, but for ordinary purposes it would be an unnecessary complication. As constructed, the hand-wheel of the multi-step rheostat can be moved from end to end in less than ten seconds. In practice this extreme movement would hardly ever be required, as the normal position of the rheostat in operation would be somewhere about midway, and variation would start from there.

Whilst 600 equal steps will be found satisfactory and sufficiently fine for most purposes, there is nothing to prevent graduation of the main resistance of the multi-step rheostat. With such an arrangement the fine regulator of the combination would be stepped to give equal

Fig. 5.—Standard Multi-Step Rheostat.

gradations over the important portion of the range, giving increments of, say, 1/1,200th to 1/1,800th of the total resistance per step. The effect of this at the unimportant parts of the curve may result in unevenness equivalent to, say, 1/300th to 1/200th of the total resistance—in other words smoother regulation at the unimportant parts of the curve than was formerly obtainable at critical points, and infinitely better regulation at the point where it is wanted.

Fig. 5 shows externally the complete multi-step rheostat.

The Audiophone.—A telephone receiver that fits into the lower cavity of the ear has been developed for the use of those who are hard of hearing. The new receiver is exceedingly small, weighing only six-tenths of an ounce with the connecting cord, which is but little more conspicuous than an eye-glass ribbon. This comfortable device is used in combination with a transmitter and batteries, and has been made possible through use of the magnetic alloy "permalloy," says the *T. and T. Age*. The outfit, of which the receiver is part, is known as an audiophone. It was developed for the Western Electric Co in the Bell Telephone Laboratories as a by-product of fundamental research into the field of sound. It comprises a microphone "as large as a stack of half a dozen fifty-cent pieces," an amplifier containing two tiny vacuum tubes, the necessary batteries and the "ear" receiver. The outfit will normally comprise a microphone, worn in the coat lapel, an amplifier in a box, which may be carried in the hand or placed on a table or desk, and the receiver, which is worn in the ear. Using it, a person who has lost sixty per cent. of his hearing can again follow the conversation in any ordinary sized room. Without the audiophone's aid, such a person, or one of only fifty per cent. loss, could not understand anything of an ordinary conversation. The cartilages of the outer ear are rigid enough so that when an impression is taken and a moulded fitting made and inserted, they will support the little receiver with complete comfort to the wearer. The use of permalloy, the nickel-iron alloy, in the magnetic circuit of the tiny receiver makes it more sensitive; it also prevents acoustic shock.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

Engineering Merger Confirmed.—The scheme for the amalgamation of the Mirrlees, Watson Co., Ltd., and Mirrlees, Bickerton & Day, Ltd. (outlined in our issue of March 19th, p. 456), was confirmed at an extraordinary meeting on April 2nd. The increasing of the company's capital to £600,000 was approved and additional directors were appointed.

New Municipal Showrooms and Offices.—Last week the Lord Mayor of Belfast informally opened the new offices and showrooms recently constructed in connection with the Electricity Department of the city. We have received a set of photographs from Mr. Johnstone Wright, the city electrical engineer, which show the new premises to be very commodious and well laid out; they include an installation department and test house. Buildings at the old East Bridge Street station have been adapted for the purpose, an existing glass roof being retained to provide ample lighting both by day and night (in the latter case exterior roof lighting is employed). The showrooms consist of a Jacobean entrance hall, an oak-panelled inquiry office, a general showroom for small domestic appliances, fires, fittings, &c., a waiting room furnished as a sitting room with a "Magicoal" antique hearth fire, an electric kitchen, and a bathroom. Provision has also been made for a demonstration hall. The offices and showrooms are all electrically heated. Fig. 1 is a view of the exterior of the premises; fig. 2, the inquiry hall; fig. 3, the kitchen, in which alternative patterns of cookers, washers, &c., are shown; and fig. 4 depicts a corner of the general showroom devoted mainly to fires of various types.

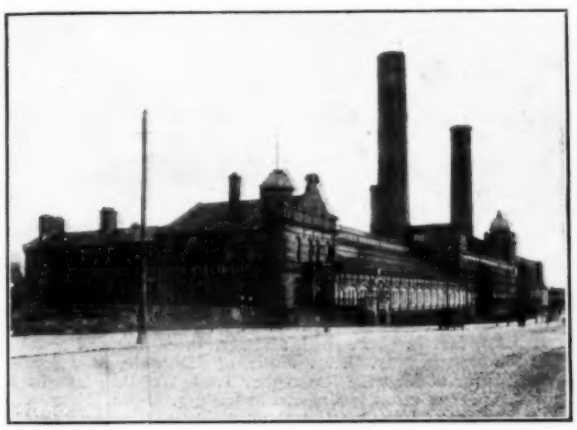


Fig. 1. Exterior.

Fig. 2. Inquiry Hall.

Fig. 3.—The Kitchen.

Fig. 4.—A Corner of the General Showroom.

Belfast's New Offices and Showrooms.

The Accrington Corporation Electricity Department is to erect new electricity showrooms at the junction of the Whalley and Burnley roads, at a cost of £3,000.

On April 8th, the Birkenhead Corporation will open its new electricity showrooms in Grange Road West. The ground floor is set aside for general lighting fittings, fires, table standards, &c., and the first floor for kitchen accessories, carpet cleaners, washers, &c.

A Report Upon Uruguay.—Mr. H. W. Reid Brown, British Vice-Consul, Montevideo, has forwarded to the Department of Overseas Trade a report upon the financial and economic conditions in Uruguay (Stationery Office, 9d. net). This shows that Great Britain held the second position in Uruguayan import trade with a share of $11,393,046 out of a total of $62,228,753 for 1924.

Wages in the Engineering Industry.—Speaking at the annual dinner of the Machine Tool Trades' Association on March 30th, Mr. J. T. Brownlie, president of the Amalgamated Engineering Union, said that, although at present adverse conditions prevailed in the engineering industry, he was not without hope that it would soon come back into its own, and that skilled workmen would receive the wages to which they were entitled. Referring to threats of a national lock-out, he said that the country would not permit such action. He hoped that when the unions and the Engineering and Allied Employers' Federation came together in conference in a few weeks' time wiser counsels would prevail, and that the Federation would adopt the suggestion which he had made 18 months ago that the employers should mortgage the future by granting increased wages. That would be the soundest investment that they had ever embarked upon.

The German Radio Industry.—At a meeting of the Verband der Funkindustrie, held in Berlin at the end of last month, it was stated that, despite the extraordinary increase in the number of users of radio apparatus, many factories engaged in the production of such apparatus had been closed. Since the beginning of broadcasting in Germany 59 per cent. of the firms who had engaged in the manufacture of wireless apparatus had been compelled to discontinue production, leaving it in the hands of a limited number of efficient firms who turn out superior apparatus.

Lantern Slides.—MESSRS. PETTERS, LTD., of Yeovil, have prepared a series of lantern slides, illustrating their oil engines, which they will be pleased to lend to authors of lectures and papers on internal-combustion engines.

The Sydney Electricity Department.—According to the Sydney *Daily Telegraph*, the Labour aldermen of the City Council are determined to give preference to Australian tenders for the generating plant required by the Council, in spite of any recommendations to the contrary. Reporting upon the Council's proposal to sell electrical appliances and fittings, the acting general manager of the Electricity Department (Mr. S. Y. Maling) says:—"It is almost certain that great opposition will be met if efforts are made by the Council to purchase apparatus in bulk locally, but local buying should be given a trial. If this fails, then apparatus should be bought in bulk abroad; and while the general manager (Mr. Forbes Mackay) is abroad is an opportune time to launch this scheme, as he could make arrangements for purchase and shipment." At a meeting of the Electricity Committee it was alleged that electrical appliances were being imported and sold at extortionate prices. Despite a good deal of adverse criticism, the Committee decided to recommend the Council to adopt a trading scheme.

Calendar.—As Easter comes round, the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., issues from Trafford Park a "Girl" calendar for the coming year. This time the Company's Publicity Department has again made a pleasing selection—Miss Violet Hemming, who is at present playing in "Rose Marie" in America, and whose portrait—accidents omitted—will adorn our walls until the end of March, 1927.

Metro-Vick House.—During the present month the London district office and London erection staffs of the Metropolitan-Vickers Electrical Co., Ltd., will be transferred to the company's new premises, Metro-Vick House, Charing Cross Road, which will also become the home of Metro-Vick Supplies, Ltd. The administrative and executive departments of the Metropolitan-Vickers Electrical Co., Ltd., with the Traction Bureau and the Metropolitan-Vickers Electrical Export Co.'s staffs will continue at 4, Central Buildings, Westminster, which remain the registered offices of the company.

The New London Premises of the Metro-Vick Supplies, Ltd.

Sydney Alderman and a Directorship.—The Sydney *Daily Telegraph* reports that a prospectus was recently issued by a company formed to manufacture electrical fittings, and among the directors was Alderman J. H. Mostyn, described as "Chairman, Electricity Committee, City Council, Sydney." In another part it was stated: "This means that for new work alone 156,000 small fittings are required for the Sydney City Council service." In an interview, Alderman Mostyn denied that the company was floated to supply special fittings to the Council as some people thought; it was formed to give an opening to an Australian invention which could be manufactured and sold in Australia.

The Swedish Electrical Industry.—The *Swedish Economic Review*, the official journal of the Swedish Board of Trade, states that the machinery industry showed a decided improvement during 1925. The exports of electrical machinery rose in value from 17.7 million kronor (£983,333) in 1924, to 21 million kronor (£1,166,666) in 1925. At the same time the value of exported telegraph and telephone apparatus fell from 7.5 million kr. (£416,666) to 7 million kr. (£388,888). The exports of this apparatus for January were very low, reaching a value of only 198,000 kr. (£11,000).

The E.D.A. Staff at Olympia.—The staff of demonstrators at the "Electric House" arranged at the recent Ideal Home Exhibition, Olympia, by the British Electrical Development Association, had a very busy time and did much to further the "electrical idea." We reproduce a photograph of these ladies and gentlemen; the ladies appear to be greatly attached to their charges.

The E.D.A. Staff at Olympia.

East Kent Contractors' Dinner.—The East Kent Branch of the Electrical Contractors' Association held its annual dinner on March 24th. Mr. D. McKellar (chairman) presided, and he was supported by Mr. T. E. Alger (president of the E.C.A.), Mr. L. C. Penwill, and Mr. P. A. Bennet, secretary of the branch. Mr. G. M. Willis, of Ramsgate, in welcoming the Mayor of Margate (Councillor T. D. Wood), touched upon the subject of municipal electrical trading. He said that while contractors had no objection to municipal authorities supplying electricity or gas, they considered that the wiring of buildings and the supply of fittings should be left to them. The Mayor, in reply, said that he knew little of the subject. He extended an invitation to the E.C.A. to hold its 1927 meeting at Margate. The Chairman proposed the toast of the Association, and mentioned that the branch had increased in size by 30 per cent. during the past year. Mr. T. E. Alger, who responded, spoke against municipal trading, and said that every new department set up by a local authority created another set of officials. Contractors should not imagine that the Government's Electricity Bill was going to increase their business immediately. It might have that effect in eight or ten years' time. Reverting to municipal trading, he said that to save time and expense, a Committee of both Houses of Parliament should be set up to settle the matter once and for all. He considered that the Committee on the Colwyn Bay Bill was prejudiced from the start; the Association had been more successful regarding the Doncaster Bill. Mr. Alger appealed to contractors to become registered, and he also expressed his regret at the recent death of Mr. L. G. Tate. Other toasts submitted were "The Electrical Supply Authorities," proposed by Mr. J. Martin and replied to by Mr. C. F. Hume (Ramsgate and District Electric Supply Co., Ltd.); and "The Manufacturers and Wholesale Traders," proposed by Mr. C. H. Roberts and responded to by Messrs. H. F. Roberts (G.E.C.) and T. Hudson (Henley's).

South Shields Tramways Dispute.—The *Newcastle Chronicle* reports that the Electrical Power Engineers' Association has warned the South Shields Tramways Committee that it will deprive the system of power by the withdrawal of some of its members unless the notice of dismissal given to Mr. F. R. Batey, the assistant engineer, is reconsidered. Mr. Batey is one of three officials whose services are being dispensed with by the Committee on the score of redundancy. The Mayor, when interviewed, stated that the dismissals were part of a reorganisation scheme by which, it was hoped, the department would become a paying concern. The notice tendered by the E.P.E.A. was to take effect yesterday (Thursday), and the matter was to be considered by the Town Council the previous day.

Recent Contracts.—THE MIRRLEES WATSON CO., LTD., has recently supplied to the Ilkeston and Heanor Water Board an electrically-driven bore-hole pump capable of delivering 35,000 gallons of water per hour.

The AUTOMATIC TELEPHONE MFG. CO., LTD., has recently completed an automatic exchange (2,000 lines) at Ipswich.

ELECTROMOBILE, LTD., has secured large orders for electric trucks in connection with Spanish railway developments, and an order for Australia for an electric locomotive. Recent Home orders include standard electric trucks for Home concerns;

electric tractors and crane trucks for the L.M.S. Railway; small electric locomotives for the Admiralty and War Office; and tower wagons for municipal tramway undertakings.

Among the orders recently received by International Combustion, Ltd., are one for complete steam-generating "Lopulco" combustion equipment, &c.; and "Lopulco" equipment for the large station in Buenos Aires for the Cia. Hispano-Americana. The company has also been appointed main contractor for the new "super" station at Congella, Durban.

Trade Announcements.—MR. A. WRIGHT (INVENTUM ELECTRICAL APPLIANCES, &C.) has removed to 124, Chancery Lane, W.C.2.

MESSRS. THOMPSON & Co. have centralised their business at their warehouse address:—1 & 3, Old Swan Lane, Upper Thames Street, London, E.C.4.

Catalogues and Lists.—MESSRS. DAVID BROWN & SONS (HUDDERSFIELD), LTD., Park Works, Lockwood, Huddersfield.—An illustrated brochure dealing with the design and manufacture of worm gearing.

BRITISH CENTRAL ELECTRIC CO., LTD., 6 and 8, Rosebery Avenue, E.C.1.—An illustrated catalogue of switchgear, cables and wires, wall plugs, adaptors, &c.

METRO-VICK SUPPLIES, LTD., 4, Central Buildings, Westminster, S.W.1.—An illustrated and priced folder advertising "Cosmos" gasfilled, vacuum, and colour-sprayed lamps.

THE DAMARD LACQUER CO., LTD., Warwick Road, Greet, Birmingham.—A brochure dealing with the moulding of "Formite" bakelite materials.

SIEMENS & ENGLISH ELECTRIC LAMP CO., LTD., 38-39, Upper Thames Street, E.C.4.—List No. 99, containing illustrations and prices of "Silvaray" one-piece glassware lighting fittings.

MESSRS. JOHN ARMSTRONG & CO. (MANCHESTER), LTD., Barton Square, St. Ann's Street, Manchester.—A blotter advertising the company's electrical contracting business.

MESSRS. FERGUSON, PAILIN, LTD., Higher Openshaw, Manchester.—Catalogue Sections Nos. 25/S1, 166/S1, and 166/S2, dealing with oil-immersed metal-clad switchgear.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—Publication O.V. 4,082, describing the company's 2-V, 0.12-A radio valves introduced a short time ago. Also the "Osram Bulletin" for March, containing notes and news of "Osram" illumination schemes, valves, and appliances, and an illustrated leaflet announcing reduced prices for "Magnet" electric fires (stocktaking bargains).

MR. ALBERT MORGAN, 138, Gower Street, W.C.1.—Illustrated pamphlets giving details of wall cranes, pulley blocks, &c.

TRELLEBORG EBONITE WORKS, LTD., Audrey House, Ely Place, E.C.1.—Pamphlets advertising the firm's ebonite.

MIDLAND FLEXIBLE METALLIC TUBING CO., LTD., Bridge Street, Long Eaton, Nottingham.—Twenty-four page illustrated catalogue relating to the company's flexible metallic tubing and connections. Views are given of various departments of the works, also particulars of flexible arms or standards for electric lighting, and electric wire and cable armouring.

DIXONIA, LTD., 4, Portsmouth Street, Kingsway, W.C.2.—An illustrated and priced catalogue of automobile accessories—mainly lighting fittings.

SHELL-MEX, LTD., Shell Corner, Kingsway, W.C.2.—A brochure dealing with "Shell" lubricating oils.

MESSRS. L. McMICHAEL, LTD., Wexham Road, Slough, Bucks.—A priced and illustrated pamphlet advertising the "M H" loud speaker filter.

THE JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, S.W.1.—April blotter, advertising the company's new boiling plate.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., U.S.A.—A number of illustrated pamphlets dealing with synchronous motors, motors for chemical works, &c.

THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication No. 428A, containing particulars and prices of "Marconiphone" amplifiers.

MESSRS. COOPER & CO., Abbey House, Victoria Street, London, S.W.1.—Leaflet describing the "Homelite" illuminated nameplate device for connecting to the hall-light switch.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Descriptive leaflet 261 devoted to high-speed air-break circuit breakers up to 1,500 V d.c.; Circular 1,292 describing "Type K" metal-clad compound-filled switchgear up to 35,000 V. Illustrated.

Bankruptcy Proceedings.—W. S. MILES, Worston Road, Burnham-on-Sea, Somerset, radio engineer.—The first meeting of creditors was held on March 31st at the Official Receiver's offices, Bristol. The statement of affairs showed gross liabilities of £769 of which £761 was expected to rank, against net assets of £43, leaving a deficiency of £718. Debtor attributed his failure to taking over a liability to his late partner of £600 and other causes. The case being a summary one, was left with the Official Receiver as trustee. The following are creditors:—

	£		£
Curtis, Thomas	600	Reynolds, W. M., Ltd.	24

A. RICHARDSON, electrical engineer, 36, School Road, Sale, Cheshire.—First meeting, April 9th, at the Official Receiver's offices, Byrom Street, Manchester; public examination, May 14th, at the Court House, Manchester.

C. G. HOFMAN (L. J. Chambers & Co.), wireless components manufacturer and electrical engineer, Andrew Works, Courthope Road, Wandsworth Road, S.W., and 7a, Victoria House, South Lambeth Road, S.W.—Bankrupt's discharge suspended until March 5th, 1928.

D. C. FIELDING, wireless dealer, 48a, Cloth Market, Newcastle-on-Tyne.—Trustee, Mr. J. C. Blakey, 28, Pilgrim Street, Newcastle-on-Tyne, released March 12th.

Company Liquidations.—JOHNSON, SAVAGE & Co., LTD., wholesale electrical and radio suppliers, 66, Margaret Street, W.—A meeting of creditors was held on March 31st at the offices of the London Auction Mart, when the chair was taken by Mr. P. Barber, who had been appointed to act as liquidator in the voluntary liquidation of the company. A statement of affairs was presented, which disclosed liabilities of £1,647, all due to unsecured creditors. In addition, there were debentures and interest amounting to £632. The net assets were £61, leaving a deficiency of £1,586. The liquidator said that the debentures were issued in 1924 for cash advanced to the company by Mr. Archard and his son. The liquidator further stated that he had been appointed receiver for the debenture holders on March 16th last. The company was formed in June, 1922, with a nominal capital of £1,000. The subscribed capital was £615, of which £395 represented cash and £218 the consideration for the business taken by the company. The accounts for the year to June, 1923, showed a turnover of £5,502 and a net profit of £52. For the following year the turnover was £5,640, and there was a net loss of £838, and for the year to June, 1925, the turnover was £5,229, and there was a further loss of £209. The meeting broke up without any resolutions being passed; therefore the voluntary liquidation of the company will be continued with Mr. Barber as liquidator. The following are creditors:—

	£		£
Foster Engineering Co.	59	London Commercial Electric Stores	49
Hirst Bros. & Co., Ltd.	23	Grotte & Sohne	45
Engineering Supplies, Ltd. ...	36	Power Equipment Co.	27
Hornby, Robert, & Co.	26	Stewart, J. H., & Co.	81
Wilkins & Wright, Ltd.	20	Leigh Bros.	26
Prek, J.	35	Kersans Mfg. Co.	24
Bedford Electric Radio Co., Ltd.	41		
Lighting, Heating & Glass, Ltd.	111		

DOMESTIC AND GENERAL ELECTRICAL CO., LTD., Hampden House, Kingsway, W.C.—A meeting of creditors was held on April 7th at the offices of Messrs. Corfield & Cripwell, E.C. Mr. W. A. J. Osborne, the liquidator, submitted a statement of affairs which disclosed liabilities of £619 and net assets of £190, leaving a deficiency of £429. Mr. Osborne stated that the company was registered on December 6th, 1924, with a nominal capital of £1,000, divided into 100 preference and 100 ordinary shares of £5 each. There had been issued 30 preference and 100 ordinary shares, or a total of £650. All the preference shares were allotted for cash. The ordinary shares were issued to the vendor, Mr. H. A. Purdie, in satisfaction of the purchase price of the business which was sold to the company. Mr. Osborne said that, so far as he could see, the company had carried on business at a loss from its inception. The deficiency, as regarded the shareholders, was £1,079, and that amount was accounted for by goodwill written off, depreciation of assets, and losses on trading. A resolution was passed confirming the appointment of Mr. Osborne as the liquidator of the company. The following are creditors:—

	£		£
Capel & Co.	54	Sun Electrical Co., Ltd. ...	27
General Electric Co., Ltd. ...	112	Hornby, Robert, & Co., Ltd. ...	52
Macintosh Cable Co., Ltd. ...	26	Smitherman, W. H.	33
Power Laundry	47	Purdie, F. S.	28
St. Helens Cable & Rubber Co., Ltd.	67	Purdie, H. A.	95

BUCKS ELECTRIC WIRE & ENGINEERING CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. A. J. Osborne, Balfour House, Finsbury Pavement, E.C. Meeting of creditors, April 15th, at Balfour House, E.C. Particulars of claims to the liquidator by May 10th.

INGLEBY & Co., LTD.—A meeting of members is called for May 13th at 6, South Parade, Leeds, to hear an account of the winding up from the liquidator, Mr. R. E. Starkie.

Private Arrangements.—W. A. SIMESTER, Brighton, wireless factor, &c.—A meeting of creditors was held recently at the offices of Messrs. Orbell & Kirk, Brighton. The statement of affairs showed liabilities of £813 and net assets of £374, leaving a deficiency of £439. It was stated that the debtor's wife was a cash creditor, and her claim could not rank in competition with those of the other creditors. The debtor commenced business in 1919. He had little or no capital of his own, and borrowed £123 from his wife, which was still outstanding. The debtor had carried on business as a factor, his turnover averaging about £2,500 per annum. The deficiency was accounted for by loss on trading and bad debts. The latter had amounted to more than £200. A resolution was passed in favour of the matter being dealt with under a deed of assignment, with Mr. A. E. Orbell as trustee, with a committee of the three principal creditors. The following are creditors:—

	£		£
London Engineering Works, Ltd.	55	Stentophone Motor Accessories, Ltd.	144
Edmonds, H., & Co.	120	Webb, W. F. & M.	22
Maglen, A. P., Ltd.	43	Woolf, M. & A.	34
Ward & Goldstone, Ltd. ...	123		

Dissolution of Partnership.—F. H. BARRELL & Co., electrical and general engineers, 2a and 2b, Church Street, Staines.—Messrs. F. J. Slough, A. V. Keale and F. H. Barrell have dissolved partnership. Mr. Barrell will attend to debts.

Unemployment.—The total number of registered unemployed on March 22nd was 1,039,400, as compared with 1,070,833 on March 15th and with 1,201,315 on March 23rd, 1925.

Book Notices.—"Reid's Handy Colliery Guide for Northumberland, Durham, Yorkshire, Cumberland, and Westmorland," 1926 edition. Pp. 242. Newcastle-upon-Tyne: Andrew Reid & Co., Ltd. Price 3s. 6d.—This new issue has been revised and brought up to date from the latest official returns and other sources of information. A list of colliery owners in the respective counties, together with particulars of the collieries and their management is included. The Coal Mines Act, 1911, is reprinted in this work, which also includes the various statutory rules and Orders issued since the Act came into force.

"The Great Public Services of Italy," by Constanzo Ciano (Italian Minister of Ways and Communications). (15 pp., illus.). London: Italian State Railways Touring Office.—This booklet has been prepared to show the improvements which have been made in the past year or two in means of travelling and communication in Italy. It shows, *inter alia*, that the electrified mileage of railways increased from 288 km. in 1913-14 to 457 km. in 1920-21, and 855 km. in 1924-25.

"The Municipal Year Book, 1926." (Pp. lxxxiii+896). London: Municipal Journal, Ltd. Price 15s. net.—This handy reference work has been brought up to date and, as usual, includes a section giving the latest available financial results of the working of municipal electricity undertakings. It is worthy of note that only 12 undertakings out of over 300 failed to make a profit.

"Elementary Electrical Engineering, Theoretical and Experimental," by O. R. Randall. Pp. vi+233; figs. 177. London: Sir Isaac Pitman & Sons, Ltd. Price 5s. net.

"Loud Speakers: Their Construction, Performance, and Maintenance," by C. M. R. Balbi, A.M.I.E.E., A.C.G.I. Pp. xv+96; figs. 57. London: Sir I. Pitman & Sons, Ltd. Price 3s. 6d. net.

"The *Journal* of the South African Institution of Engineers." Vol. XXIV, No. 8. March, 1926. Price 2s.

New French Company.—La Compagnie Electrique du Midi is the name of a new undertaking which has lately been organised in Toulouse with a capital of 2 million fr. to establish electricity distribution systems in the Rouergue, Query, and neighbouring districts.

New Businesses.—The following new electrical businesses have recently been started:—

"Mellowtone" (wireless manufacturers), Triumph House, 189-191, Regent Street, W.1.

Sleaford Electric Supply and Battery Service (general electrical and other repairs), 89a, Southgate, Sleaford.

Gibson, Wyatt & Co. (electrical engineers and suppliers), 40, Finsbury Square, E.C.2.

William Watson & Co. (electrical engineers and contractors), 16, New Durham Road, Sunderland.

Reliance Radio Manufacturing Co. (manufacture of wireless components), Little Gransden, Sandy, Beds.

Stubbs Wireless Depôt, 471, Green Street, Upton Park, E.

Uneeda Magneto Co. (general electrical repairers), 5, Cross Fountain Street, Leeds.

Reliable Battery Service (accumulator charging), 597, Green Lanes, N.8.

Electric Automatic Sign Co. (manufacturers and distributors of electric signs), 54, Gracechurch Street, E.C.3.

Old Swan Accumulator Co. (accumulator charging), 26, Stoneville Road, Old Swan, Liverpool.

Stanley & Co. (wireless and electrical engineers), 122b, Chase Side, Enfield, Middlesex.

Service Supply Co. (electric lamps and wireless valves), 1, Bangor Street, Cardiff.

Electric and Model Engineering Co. (manufacturers of electrical fittings, radio and general engineers), Station Approach, New Malden, Surrey.

York Radio Supplies (factoring radio goods), Coffee Yard, Stonegate, Yorks.

Rendel Supplies (dealers in radio and electrical equipment, &c.), 5, Hope Street, Brierfield, Lancs.

Universal Bracket Co. (aerial equipment supply), Alpine Steelworks, East Molesey, Surrey.

P.W Radio Service, wireless retailer, at 47, Barking Road, Canning Town, E.16.

Jackson's Nofolt Wireless, wireless dealer, at 6, Warwick Street, W.1.

T. Hamnett, electrician, at Curon Street, Plymouth Grove, Chorlton-on-Medlock.

The Radio Stores, wireless accessories and repairs, at Southey Street (over J. Peel's), Keswick.

Westminster Electrical Co., electrical and wireless wholesalers, at 2, Tanswell Street, Lambeth, S.E.1.

Delcoe Accumulator Service Station, general maintenance and sale of accumulators, electrical engineering, at 165a, Percy Road, Shepherd's Bush, London.

For Sale.—Messrs. H. Butcher & Co. will sell by auction on April 15th and 16th, at the Strode Engineering Works, Herne, Kent, miscellaneous electrical stores, lighting sets, batteries, cables, &c.

Local Exhibition.—Evesham.—The Shropshire, Worcestershire, and Staffordshire Electric Power Co. recently organised an electrical exhibition at Evesham, and a number of leading firms participated. Domestic appliances and lighting fittings were shown by the General Electric Co., Ltd., the British Thomson-Houston Co., Ltd., and the Cable Accessories Co., Ltd. The B.T.-H. Co. also installed radio reproducing apparatus. Messrs. W. & T. Avery showed scales and the Singer Sewing Machine Co., Ltd., exhibited examples of its electrically-driven machines. The Power Co. itself arranged a suite of rooms—dining-room, kitchen, scullery, bathroom, and bedroom—and equipped each room with appropriate electrical appliances. In addition, the company set up a model shop-window with special lighting arrangements. Films dealing with electrical subjects were exhibited during the show, and lectures were given by Miss Margaret Partridge, B.Sc. (E.A.W.), Mr. V. Dale (E.D.A.), and Mr. G. F. Francis (B.E.A.M.A.).

Manchester.—A Better Housing and Housekeeping Exhibition is to be held from to-day (Friday) to May 1st. Among the exhibitors is the Central Cables & Accessories, Ltd., which is showing the "Central" vacuum cleaner with a rotating brush and the "Centralette" pattern with a fixed brush.

A Report on East Africa.—Mr. C. Kemp, Deputy Trade Commissioner, has forwarded to the Department of Overseas Trade a report upon the trade and commerce of the Uganda Protectorate, Kenya Colony and Protectorate, Zanzibar and the Tanganyika Territory (Stationery Office, 1s. 6d. net). In the course of this it is stated that, while the United Kingdom still secures practically the whole of the trade offering in electrical goods and apparatus, a certain amount of competition from Germany is in evidence, and will probably increase at a later date. The large increases in the imports of machinery are said to be direct evidence of the recovery of the market. An appendix to the report contains the following information relating to the imports of electrical goods and apparatus for the first six months of 1924 and 1925, the figures in parentheses indicating the percentage supplied by the United Kingdom:—Kenya and Uganda: 1924, £19,975 (91); 1925, £13,555 (97); Tanganyika: 1924, £6,229 (89); 1925, £4,210 (85). Zanzibar: 1924, £27,423 (95); 1925, £4,336 (76). The figures for the whole of 1924 were:—Kenya and Uganda, £28,945 (96); Tanganyika, £9,626 (80); and Zanzibar, £17,636 (84).

The Osaka Electrical Exhibition.—In the scientific domain nothing has made such wonderful progress in Japan as the application of electricity to all branches of activity. It was in 1918 that the first Japanese electrical exhibition was held in Tokio. This exhibition was a colossal success, and proved a considerable stimulus to the development of Japan's electrical industry, which has since made great strides. A second exhibition in two parts is being held in Osaka, one near the Osaka Harbour and another at Tennoji Park, both simultaneously under the auspices of the Electrical Association of Japan. The exhibits comprise electrical plant and machinery, electric furnaces, motors, ship's electrical appliances, testing instruments, radio sets, household electrical appliances, medical instruments, agricultural implements and, in fact, all kinds of equipment, appliances, inventions and devices in any way connected with the use of electricity. Demonstrations of the various exhibits are being made under actual working conditions. The exhibition will remain open until May 31st. The keen interest with which the exhibition is regarded by the public may be gauged by the fact that more structures than originally planned had to be built in order to meet the demand for exhibition space.—*Reuter's Trade Service* (Osaka).

Social Events.—The staff of the Woolwich Borough Council Electricity Department held its second annual dinner at the Old Town Hall, on March 27th. Mr. S. H. Penning, A.M.I.E.E. (deputy borough electrical engineer), presided, and he was supported by the Mayor of Woolwich (Councillor W. Barefoot, J.P.), Councillor T. Davis (chairman of the Electricity Committee), Alderman T. Watt (vice-chairman of the Electricity Committee), Councillors J. Newman, R. W. Marsh Allen, V. Lister and H. Sykes, Mr G. W. Keats (borough electrical engineer), Mr. J. C. Williams (Erith), Mr A J. Abraham (Bexley), Mr. F. H. Edwards (Dartford), Messrs. L. C. Chasteauneuf and J. A. Turnbull. The chairman proposed the toast "His Worship the Mayor of Woolwich," and the Mayor expressed the thanks of the Council to the staff for the success of the electricity undertaking. Councillor T. Davis proposed the toast of "The Electricity Undertaking and Borough Electrical Engineer," and said that this year the undertaking was giving the ratepayers an "Easter egg" of £25,000. Mr. Keats, in responding, stated that the Woolwich undertaking was second in London and seventh in Great Britain for efficiency, a position which was a great credit to the men in every department. Furthermore, the Woolwich undertaking had carried out more pioneer work than any undertaking in the Kingdom. He referred particularly to the all-electric houses at Eltham. Alderman T. Watt proposed the toast of "The Staff and Employés of the Electricity Undertaking," and Mr. S. H. Penning replied. Mr. G. R. Smith proposed the toast "Our Guests," and Mr. J. C. Williams responded. An excellent musical programme was carried out.

The annual dinner of the staff of the Ilford Council's Electricity Department took place on March 29th. Mr. A. Shaw, the chief electrical engineer, was in the chair, and during the course of the function was presented with an oak hall cupboard to mark his completion of 25 years in his present position. A number of speakers testified to Mr. Shaw's ability and the progress of the Department under his guidance. A first-class musical entertainment was provided.

Polish Foreign Electrical Trade.—*The Board of Trade Journal* reports that the imports of apparatus, conductors, and other electrotechnical materials into Poland during January were valued at 2,267,000 zloty (about £60,000), and the exports of these goods at 96,000 zloty.

Copper, Lead, and Rubber Prices.—Messrs. F. Smith and Co. report, April 7th: No change in electrolytic copper prices.

Messrs. James & Shakespeare report, April 7th: Copper bars (best selected), sheet, and rod, no change; English pig lead, £31 5s., 10s. dec.

Messrs. Edward Till & Co. report, April 7th: India-rubber, Para fine, 2s. 2½d., ½d. dec.

Lighting and Power Notes.

Aberdeen.—WIRING OF SMALL HOUSES.—The Corporation Electricity Committee has recommended the introduction of a scheme by which the Town Council will wire houses through private contractors on the deferred payment system.

Accrington.—NEW SUB-STATIONS.—New sub-stations are being erected in Sydney Street at an estimated cost of £1,600; in Willows Lane, at a cost of £887; and in Oswaldtwistle, at a cost of £1,640.

Argentina.—BUENOS AIRES.—A contract has been signed with the Compania General de Obras Públicas for the construction of a hydro-electric power station at the Port of Buenos Aires. Five 130,000-h.p. generators are to be installed. Two sets only will be proceeded with at first, one of which, it is expected, will be in operation by the end of 1927.—*Reuter's Trade Service* (Buenos Aires).

Barking.—PRICE REDUCTION.—The Urban District Council has reduced the charge for electricity to small consumers for lighting from 7d. to 5d. per kWh.

Beckenham.—LOAN.—The Electricity Committee has decided to apply for sanction to an additional loan of £20,000 for mains and services.

Bexley.—NEW ELECTRICITY TARIFF.—The Urban District Council has adopted a new tariff for the supply of electricity. Lighting for domestic and business purposes is to be charged at a flat rate of 6½d. per kWh, and heating and cooking at a flat rate of 1d. There will also be a contract rate of 2s. 6d. per quarter for each 50 watts or portion thereof installed for lighting purposes, plus 1d. per kWh for electricity consumed for lighting, heating, power, &c.

Blackburn. — LOAN. — The Corporation is applying for sanction to the borrowing of £100,000 for mains and services.

Bognor.—PRICE REDUCTION.—The Bognor Gas Light and Coke Co. has reduced the price of electricity for lighting to 7d. per kWh, flat rate.

Chester.—OBJECTION TO SCHEME.—At a recent meeting of the Electricity Committee, the town clerk stated that he had sent a letter of protest to the Electricity Commissioners against the proposal of the North Wales Power Co. to erect a transmission line from Helsby to Crewe, passing through the area in which the Corporation was seeking powers to supply electricity, before the Corporation had had the opportunity of stating its case in support of its application.

Cirencester. — ELECTRICITY SUPPLY. — The Rural District Council has consented to the applications of the West Gloucestershire Power Co., Ltd., to supply electricity in the Council's area, and the Cirencester Electric Supply Co., Ltd., for the extension of its overhead mains to Stratton.

Continental.—SWITZERLAND.—The Swiss Government has granted a concession to Buss & Co., of Basle, and the Lonzawerke Gesellschaft, of Waldshut, for the establishment of a new hydro-electric station at Rekingen on the Rhine, to utilise the power of the river between Eglisau and Rheinfelden. The capacity of the plant will be about 43,000 h.p.

BELGIUM.—The Société de Gaz et d'Electricité du Hainaut reports that during the past year concessions were secured for the supply of electricity to five additional communes, bringing the total supplied up to 69. Work on the new power station at Farciennes has been somewhat delayed by labour disputes, but it is expected to be ready for operation within a few weeks.

AUSTRIA.—It is proposed to establish a large central electricity station at the coke-making plant at the Ignatz collieries of the Berg und Huttenwerk Gesellschaft at Marienberg, near Mahr-Ostrau. The electricity generated is to be transmitted to the distribution system of the Mahrisch-Schlesischen Elektricitats Gesellschaft.

Dalkeith.—PURCHASE OF UNDERTAKING.—The Town Council, on April 1st took over the control of the electricity undertaking which has been purchased from the Electric Supply Corporation, Ltd., at a cost of £18,000. Mr. R. Smith is resident engineer. An agreement has been entered into with the Lothians Electric Power Company for a bulk supply of electricity. Messrs. Buchan & Partners, Edinburgh, are the consulting engineers.

Eccles (Lancs.).—LOAN.—The Town Council has applied for sanction to a loan of £6,000 to replace the original mains laid down in 1893.

Glossop.—PROPOSED PURCHASE OF UNDERTAKING.—The Corporation has appointed a committee to carry out negotiations with regard to the proposed purchase of the local electricity undertaking.

Hardingstone.—ELECTRICITY SUPPLY.—The Rural District Council has granted permission to the Northampton Electric Light & Power Co., Ltd., to erect overhead cables at Quinton and Courteenhall, and overhead and underground cables at Roade for the supply of electricity.

Harwich.—LOAN.—The Electricity Committee is applying for sanction to the borrowing of a further £1,000 for electricity services.

High Wycombe.—PRICE REDUCTION.—The High Wycombe Electric Light & Power Co. has announced a reduction in the price of electricity for lighting, from 9½d. per kWh for the first 100 kWh per quarter, and 9d. beyond, to 9d. and 8d. respectively.

Leeds.—ELECTRICITY SUPPLY.—In connection with the City Council's proposal to erect a new power station on Red Cote Farm estate, the Electricity Commissioners have intimated their reluctance at the present time to favourably consider an application for sanction to proceed with the construction of a new electricity generating station, being of the opinion that the present shortage of generating plant in Leeds and neighbouring towns can be temporarily met by linking up the various centres, and have requested the undertakings concerned to allow their engineers to meet in conference to consider this suggestion and, if possible, to submit their conclusions to the Commissioners at an early date. The Committee has decided that the manager be instructed to attend the conference.

The Committee has recommended the acquisition of the Red Cote Farm estate, at a cost of £18,500, for electricity purposes.

Llandudno.—ELECTRICITY CHARGE.—The Llandudno and Colwyn Bay Electric Railway, Ltd., has written to the Council pointing out that the reduction in the price of the electricity offered by the Council is inadequate, and suggesting that, having regard to the requirements of the company and to the fact that the supply is taken at the switchboard at the works, the rate should not exceed 1.20d. per kWh. The Electricity Committee has decided to adhere to the terms agreed to at its last meeting. It was decided to call the attention of the company to the amount outstanding for electricity supplied and to ask for an early settlement.

Mansfield.—WIRING OF SMALL HOUSES.—The Town Council has adopted a scheme for the assisted wiring of houses for electric lighting. The scheme is to apply only to houses and shops already supplied with gas, and not to new property, and the additional charge will be 2d. per kWh. Consumers will buy their own lamps after the first installation, and for a period of six months contracts are to be entered into with local firms for the wiring of blocks of houses on the Chesterfield lines.

Special Orders.—Application has been made to the Electricity Commissioners for a Special Order by the Farnham Gas and Electricity Co. authorising it to supply electricity in certain parts of the rural district of Farnham.

The Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the Brecon Corporation to supply electricity in the borough and in the parishes of Castle Inn and Christ's College in the urban district of Brecknock; the South Wales Power Distribution Co., in the parish of Llantrisant, in the rural district of Llantrisant and Llantwit Fardre; the Bedford Corporation, in the urban district of Ampthill and parts of the rural districts of Ampthill and Biggleswade.

Tilbury.—ELECTRICITY SUPPLY.—The Urban District Council has decided to enter into an agreement with the County of London Electric Supply Co., Ltd., for a supply of electricity, and to take the necessary steps to apply for a Special Order to supply electricity in the town.

Twickenham and Teddington.—ELECTRICITY CHARGES.—As a result of the recent inquiry, the Ministry of Transport has fixed the maximum rate to be charged for electricity by the Twickenham and Teddington Electric Supply Co., Ltd., at 9d. per kWh. The company has given notice that the following scale of charges has been adopted from the reading of meters at the end of the March quarter:—Lighting, 8d. per kWh, subject to a reduced minimum charge. Power: First 3,000 kWh per quarter, 2½d.; next 30,000, 2d.; above this amount, 1½d. Contract tariff: 2d. per kWh. Heating: First 100 kWh per quarter, 3½d.; beyond, 2d.

United States.—HYDRO-ELECTRIC DEVELOPMENT.—According to the *Electrical World*, plans are under way for a consolidation of the Carolina Power and Light Co., the Yadkin River Power Co., the Asheville Power and Light Co., the Pigeon River Power Co., and the Carolina Power Co. The new company will be called the Carolina Power and Light Co., and steps will be taken immediately on construction work, which will involve the expenditure of approximately $20,000,000. Included in the contemplated construction work is a new hydro-electric plant on the Yadkin River at the Norwood site. This plant is to be designed for an ultimate capacity of 85,000 kW. The initial installation will be 63,000 kW. Another hydro-electric plant on the Pigeon River on a site near the Tennessee State line will be constructed. This plant will be designed for an ultimate generating capacity of about 75,000 kW, and will have an initial installation of 50,000 kW.

Uttoxeter.—Electricity Supply.—The Power Development Co., Ltd., has informed the Rural District Council of its intention to apply for a Special Order to distribute electricity in the rural districts of Uttoxeter, Cheadle and Stone, and in the urban district of Uttoxeter, and has asked for an opportunity of discussing the matter with the Council, whose consent is asked for. The Council has decided to await the decision of the Urban District Council on the matter.

West Lancashire.—Electricity Supply.—The Rural District Council is to apply for an Order to enable the townships of Maghull and Lydiate to obtain a supply of electricity from the Liverpool Corporation at the Aintree boundary. At a recent meeting of the Council it was objected that the price proposed by the Liverpool Corporation was 2¾d. per kWh, whereas a cheaper supply might be obtained from the L.M. & S. Railway Co., which was supplying Formby at ¾d. per kWh. The clerk said that the Council was already pledged to go forward with the scheme.

Wetherby.—Electricity Supply.—At a recent meeting of the Rural District Council notice was received from the Electricity Commissioners that they were granting the Electrical Distribution of Yorkshire, Ltd., power to supply electricity to Wetherby. The company has issued notice of its intention to commence laying mains at Collingham, Linton, Wetherby, Thorner, Boston Spa, and East Keswick within a month.

Tramway and Railway Notes.

Blackpool.—Tramway Improvements.—The Corporation proposes to spend £143,808 on tramway improvements during the next financial year. The proposed improvements include new cars and equipment, £15,650; mineral sidings, £16,698; permanent way renewals, £65,601; South Shore tramway extension, £10,809; new motor 'buses, £13,000; and new garage, £12,000.

Cardiff.—New Cars.—The Tramways Committee is to purchase 30 single-deck tramcars at an estimated cost of £73,050.

Continental.—Switzerland.—Negotiations are in hand in connection with the electrification of the railway between Munster and Lengnau.

Austria.—The Austrian State Railway authorities have recently put in operation four electric locomotives, for use in connection with express trains, which embody the use of vertical spindle motors. The engines are intended for use on hilly sections, on which they are required to pull a 500-ton train at 25 m.p.h. and a 300-ton train at 28 m.p.h., the maximum speed on the level being 53 m.p.h. They are of the six-axle type, the central four being each separately driven by an electric motor through bevel gearing, a special flexible connection being provided between the bevel wheels and the axles. The brush gear is located at the upper end of the motors. The engines weigh 91½ tons and have an overall length of 46 ft. and a wheel base of 36 ft. The front and rear pairs of wheels are 3 ft. 5 in. in diameter and the driving wheels 4 ft. 5in.

Edinburgh.—Tramway Extension.—The new extension of the Corporation tramway system from Craiglockhart to Colinton was recently inaugurated.

Japan.—Tokio.—The Tokio correspondent of the *Daily Mail* reports that the first section of the Tokio subway system will be completed in June next year, and regular service over this section, a mile and a half long, will start in the following month, according to a statement by the managing director of the company constructing the new service. A 4-minute service, with trains to accommodate 600 passengers, is planned.

Osaka.—The Osaka municipal officials have approved in principle of the formation of a company, to construct an underground railway in the city.

Maidstone.—Railless Cars.—The Town Council is recommended to install railless cars on the Barming route, where overhead lines are at present in use, at an estimated cost of £18,662.

Salford.—Through Running.—Arrangements are now complete for the new tramway service between Salford and Walkden. The through service is the outcome of negotiations between Salford Corporation and the Lancashire United Tramway Co. It is hoped to run a similar service between Bolton and Salford, and this will entail the doubling of the existing tramway track.

United States.—New Electric Railway.—According to *Electric Traction*, an electric railway for Florida is being planned. This proposed line would link up central Florida cities with the east and west coast and open up the great ridge and lake sections of interior Florida. A corporation to be known as the Florida Service Electric Railways Company will be formed with a capital of $10,000,000. The line is to be constructed in three sections. The first will run from Orlando through Apopka and north to Palatka, the second from Orlando to Tampa and St. Petersburg, and the third through Sanford to Daytona Beach and ultimately link up with Jacksonville to the north with Miami as its Southern terminus.

Philadelphia Subway Extensions.—Extension of the Broad Street subway, Philadelphia, is proposed at an additional cost of $20,117,000. This estimate includes the construction of a two-track line under the east side of the street, five stations at half-mile intervals, and operating equipment. The present subway under construction will cost $100,000,000.

Uruguay. — Railway Electrification. — The State-owned railway between Montevideo and Santiago-Vazquez is to be electrified. The work will be undertaken on behalf of the State by the Compañia Tranvias la Transatlantica of Montevideo.—*Reuter's Trade Service* (Montevideo).

Telegraph and Telephone Notes.

Canada.—Storm Damage.—Sleet and wind storms swept Central and Eastern Ontario, portions of Quebec, and the maritime provinces on March 31st. The telephone and telegraph companies were the chief sufferers owing to the unprecedented destruction of poles carrying the wires. In the Toronto district alone over 1,200 telegraph and telephone poles came down, and all services were badly interrupted.—*Reuter* (Toronto).

Czecho-Slovakia.—Telephone Economy.—Owing to the need for economy, the telephone cable extension programme for 1926 of the Czecho-Slovakian Post and Telegraph Department has been materially cut down. The line between Prague and Brunn is, however, being extended to Iglau; a cable is also being laid between Prague and Aussig to provide a connection at Dresden with the German telephone system. It is also contemplated to lay a cable between Prague and Pilsen to provide another connection with Germany at Plauen.

Germany.—Telegraph Cable.—The German Atlantic Telegraph Co., Berlin, reports receipts of 738,226 marks in 1924, and it is proposed to pay a dividend at the rate of 6 per cent. on the preference shares, as in the previous year. The directors state that the work of producing the cable that is to be laid between Emden and the Azores, where it is to be connected with the cable of the Commercial Cable Co. and the Western Union Telegraph Co., is in full course, and it is reckoned that the connection will be completed during the present year.

Guernsey.—Telephone Service.—The revenue statement and statistics of the State telephone department for the year ended December 31st, 1925, show the gross revenue to have been £16,730 (an increase of £837 on the previous year), and the net profit was £275 (£45 decrease). Subscribers' lines increased by 179 to 3,104 and the total number of lines, including junctions, by 227 to 3,730. Overhead metallic circuit wire increased by 62¼ to 2,385¼ miles, and the underground circuits increased by 778¼ to 3,928 miles. (Single wire mileages are double these figures.)

Holland.—Automatic Telephony.—The L.M. Ericsson Telephone Company has obtained a definite order for another automatic telephone station at Rotterdam, the value of the order being about Kr. 2,540,000. The Company has previously constructed two stations of this kind at Rotterdam.—*Reuter's Trade Service* (Stockholm).

Hull.—Automatic Equipment.—The Municipal Telephone Committee has received a report from the telephone manager to the effect that, in order to be in readiness for anticipated future demands, it has become necessary to advertise for tenders for additional automatic equipment. The proposal is for 2,000 lines of additional equipment, 40 per cent. to be installed in the existing premises at Wincolmlee, to relieve congestion in the Central exchange, and the remainder divided between two new exchanges situate in North and South Newington respectively. The manager has been instructed to advertise for tenders.

India.—The Telegraph System.—Our Indian correspondent reports that the Government of India is determined to rapidly modernise the telegraph system. The Creed-Wheatstone automatic system of working has been entirely replaced by modern multiplex systems, *i.e.*, Baudot, Murray and Murkrum; laboratory experiments on the Echelon method of working (*i.e.*, between more than two stations on the same wire) have been carried out with a view to its early introduction. A considerable amount of experimental work has been carried out with Baudot re-transmitters in the Research Laboratory; a four-channel set, with single-disk distributors, has been designed and tried in conjunction with two quad terminal sets through artificial lines. After a number of preliminary trials, a scheme of connection has been evolved which has now been adopted with entire success as the standard in the Department. Experiments in connection with multiplex working were also carried out in the laboratory with Western Electric valves and relays and with valves only; the experiments were very encouraging.

When purchasing stores, increasing use is being made of local sources of supply: The value of stores purchased locally rose from Rs. 5 lakhs in 1923-24 to Rs. 12 lakhs in 1924-25, while the value of stores obtained on English indent fell from Rs. 27½ to Rs. 18½ lakhs. Hard-drawn copper line wire is now being manufactured satisfactorily in India, and over 600 tons of this wire of local manufacture was purchased by the Department in 1924-25. Glass battery jars of local manufacture are also being obtained. The telegraph workshops show an increased output. The training of men in the manufacture of

high-speed apparatus has been very successful, and complete Baudot instruments and all spare parts, which were previously received from England, are now manufactured at the workshops at very favourable rates. A special machine was designed and made in the workshops to convert Wheatstone tape into Baudot tape, to prevent the loss which would have been incurred by scrapping a large stock of Wheatstone tape. In the construction branch of the workshops, 30,020 galvanised tubes for telegraph poles, and 185,214 brackets with fittings for supporting line wires were made. The output from the iron foundry weighed 664 tons.

The total line and wire mileages of the Indian telegraph system were at 94,037 and 477,839, respectively, on March 31st, 1925. There has been a considerable increase in traffic recently.

Radio-telegraphy. — RUSSIAN SERVICE. — It has been announced by Marconi's Wireless Telegraph Co., Ltd., that a radio-telegraph service from London to Moscow (Russia) was inaugurated on March 31st. Commercial and private messages are accepted at any Marconi office.

Russia.—SHORT-WAVE RADIO EXPERIMENTS.—For some time past experiments with short waves have been in progress at the Russian Soviet Government Laboratory at Nishni-Novgorod and it is reported that by the use of a 1,520-W transmitter devised by Prof. Bontch-Brouyevitch (head of the laboratory) and Herr Tabarinow, messages have been successfully transmitted to Chile and Porto Rico on wave-lengths of 83, 102, and 104 metres. The object of the experiments is to provide a practicable form of radio communication with remote parts of Soviet Russia which are not provided with telegraph communication. Prof. Boutch-Brouyevitch is also reported to be experimenting with a 100-W transmitter for use at the Chabolovka radio-telegraph station, near Moscow.

The Telegraph Service.—FOREIGN TELEGRAM RATES.—The Postmaster-General has announced that on April 1st the rates of charge for ordinary telegrams to Italy, Switzerland, Albania, Bulgaria, Danzig, Esthonia, and Jugo-Slavia, were increased by ½d. a word, and the rate to Turkey by 1d. a word. These increases were necessitated by the decision of the International Telegraph Union to raise the maximum terminal rates chargeable by the various European administrations for telegrams passing between them.

The Telephone Service.—BIRKENHEAD POLICE SYSTEM.—The Birkenhead Corporation recently installed a Relay automatic telephone equipment at the Central Police Office. The automatic system, which replaces the former common-battery method, serves 77 departments, all of which are able to communicate directly with each other without the interference of an operator. The arrangement embraces an automatic switchboard which replaces the former branch exchange and a smaller manual board, which deals with incoming and outgoing calls. The reorganisation is estimated to have cost over £2,000.

LONDON CHANGES.—An important alteration in the telephone system of London came into operation on March 29th. Within a radius of ten miles from Oxford Circus all telephone numbers now consist of a minimum of four figures. For example, "Central 56" becomes "Central 0056," which alteration has been necessitated by the coming introduction of the automatic telephone. Last year the names of certain exchanges were altered, and numbers composed of single figures were abandoned. A new exchange, to be known as Primrose Hill, has been installed to relieve Hampstead. Some 900 subscribers have been taken over, and the exchange will be extended until it deals with some 3,000 subscribers.

LONDON SUBSCRIBERS.—On March 31st there were 486,800 telephone subscribers in the London area, and they were increasing at the rate of 1,000 per week; it is declared that there are now six subscribers in London to every 21 in New York per 100 of population. London is, however, ahead of Berlin and Paris.

Radio Notes.

Australia.—NEW STATION.—A new radio-broadcasting station was opened in Sydney on March 30th.

Pennant Hill is the location of the station, which has an aerial 400 ft. high, and its maximum power is 10 kW. Reports from British listeners who may hear this transmitter will be welcomed by the B.B.C.

Frequency Control.—QUARTZ CRYSTAL METHOD.—The recent international decision to redistribute wave-lengths by the allocation of exclusive and common wave-lengths in Europe adds interest to methods of controlling transmitter frequencies. In this connection the first high-power station to utilise a quartz crystal for this purpose is the American General Electric Co.'s development plant, which is known as WGY. A piece of quartz crystal, less than one inch square and ground to a thickness a shade less than an eighth of an inch, is controlling the 50-kW transmitter's 790-kilocycle frequency assigned to the station by the United States Department of Commerce. Quartz has been utilised for controlling the regular 5-kW transmitter of WGY for several months. Beside the large transmitter's bank of eight 20-kW water-cooled tubes are two small copper-covered cabinets with dials, switches, and meters built in their faces; one of these boxes contains the crystal and a single exciting tube; in the second box is a single amplifying tube, while successive stages of amplification up to 1 kilowatt are placed in separate panels. The small slab of quartz crystal is enclosed in a metal chamber and is connected to work directly on a 5-watt tube, which, in combination, act as a high-frequency generator whose output is determined by the contraction and expansion of the crystal. The interaction of crystal and tube may be described as the setting up of a mechanical force, which is converted into an electrical force of a definite fixed frequency dependent upon the dimensions of the piece of crystal used; the thinner the crystal the higher the frequency. The five-watt tube that is directly connected to the crystal works into a 50-watt tube, resulting in the amplification of the original energy at the fixed frequency. Still further amplification is obtained by connecting the 50-watt tube to a 250-watt tube, and then a fourth stage is secured by connecting the output of the latter to a 1,000-watt tube; all the valves used up to this point are air cooled. In the next stage a metal water-cooled tube rated at 20 kW is introduced as a part of the transmitter; it was formerly used as the master oscillator (a self-excited generator), but now is excited by the preceding stages of crystal amplification, and the 20-kW tube then excites the bank of eight 20-kW power tubes of the transmitter. The General Electric Co., of America, claims to have demonstrated that crystal control may be successfully adapted to any practical power; besides the reduction of inter-station interference, there is also evidence that fading tends to decrease when the frequency is constant.

Holland.—BROADCASTING AGREEMENT.—The Commercial Secretary at The Hague (Mr. R. V. Laming, O.B.E.) informs the Department of Overseas Trade that a new contract has been concluded between the N.V. Nederlandsche Seintoestellenfabriek (of Hilversum) and the Hilversumsche Draadlooze Omroep, which terminates the contract of May, 1925, between the parties mentioned, to be operative from March 1st, 1926. Article 1 places at the disposal of the H.D.O. certain hours per week for transmission purposes, and the N.S.F. binds itself to allot the remaining hours for transmission to the H.D.O. as desired, in so far as they are not already granted to others, and not to grant the use of the transmitting apparatus to other bodies before having given the H.D.O. the option of refusal. Article 2 stipulates that so soon as the Government grants permission for the use of the second transmitter, it shall be ready for use by the H.D.O. within two months thereof, but in any case not before June 1st, 1926; it will operate on the same wave-length as the existing transmitter, and with at least the same capacity in the aerial. The H.D.O. guarantees a minimum of 31 hours per week for the old transmitter at present in use. The N.S.F. is to see that the old and new transmitters function properly, including the provision of the material and *personnel* for the control thereof. The H.D.O. binds itself not to utilise the transmitter for advertising on behalf of firms or persons competing with the N.S.F., to submit its weekly programmes fourteen days in advance to the N.S.F., and to remunerate the latter for the use of the old and new transmitters, *personnel*, materials, licence, studio, and a maximum of two line transmissions per 31 hours on the old transmitter, and 40 hours on the new transmitter. On the eventual conclusion of a permanent contract with a probable national broadcasting body, the present contract is not to be referred to as a precedent.

Licences.—STILL INCREASING.—The number of broadcast radio-telephone receiving licences in force in Great Britain on February 28th was 1,906,000; when the March returns are available it is expected that they will record over 2,000,000.

Venezuela.—BROADCASTING CONCESSION.—A concession has been granted to a native company to establish and develop broadcasting in Venezuela. The Government proposes to erect a high-power station in Caracas and stations in each of the other States. Hitherto there have been no privately-owned radio-telegraph stations, clubs, or societies in the Republic, although permission has been given to one or two oil exploration companies to erect radio-telephone stations exclusively for communication between the oilfields and their offices. Hitherto this permission has not been availed of.—*Reuter's Trade Service* (Caracas).

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Australia.—MELBOURNE.—June 16th. City Council. Turbo-alternator, exciter, and condensing plant.*

Barking.—April 20th. County of London Electric Supply Co., Ltd. Circulating-water pumps and pump-house equipment, circulating-water screening plant, and boiler-house and coal-handling plant. (March 19th.)

May 10th. Coal-unloading, storing, and reclaiming plant. (See this issue.)

May 11th. Switchgear and accessories, transformers and piping equipment. (March 26th.)

Belfast.—April 17th. Electricity Department. Automatic rotary converters with transformers, h.p. and l.p. switchgear and automatic control gear. (March 26th.)

Belgium.—April 14th. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de la Charité, Brussels. 60 kilometres of lead-covered electric wire. Particulars on application for Cahier des Charges Special, 4-326.

Bentley-with-Arksey.—April 20th. West Riding Education Committee. Electric lighting installation at Bentley Road school. Specifications, Education Department, County Hall, Wakefield.

Bolton-upon-Dearne.—April 22nd. Dearne District Electricity Board. Electric cables and accessories. (April 2nd.)

Bristol.—April 16th. Electricity Department. 140 14 in. ×14 in.×35 ft. ferro-concrete piles. (See this issue.)

Chile.—Santiago.—August 20th. Chilean State Railways. Signals, telegraphs and telephones, electrical material for sub-stations, aerial lines, and lighting.*

Dartford.—April 21st. Electricity Department. Coal for 6 or 12 months. (See this issue.)

Dover.—April 14th. Electricity Department. 6,250 yd. e.h.p. cable. (March 26th.)

Dundee.—April 20th. Education Authority. Electric lighting at new central Advanced School at Blackness Road. Schedules from Messrs. Maclaren, Soutar & Salmond, architects, 16, South Tay Street, Dundee.

Exeter.—May 11th. Electricity Department. Boiler-house plant complete:—Two water-tube boilers with economisers, pumps, coal bunkers, conveyor, and accessories. Self-supporting steel chimney, induced-draught fan, and accessories. (See this issue.)

Ferry Fryston (Yorks.).—April 20th. West Riding County Council. Electric lighting installation at Ferry Fryston, Airedale, new school. Specifications from Education Department, County Hall, Wakefield.

Glasgow.—April 13th. Lighting Department. Materials for one year from June 1st, including electrical fittings and accessories. Specifications, &c., from office of Lighting Department, 20, Trongate.

Halifax.—April 12th. Town Council. Wiring for electric lighting of 80 houses, Booth Lane and Nursery Lane. Particulars from Mr. P. Saunders, town clerk, Town Hall.

Harrogate.—April 25th. Electricity Department. H.p. and l.p. switchgear for sub-stations. (See this issue.)

Hull.—Telephones Committee. Supply and installation of automatic telephone exchanges. (April 2nd.)
April 15th. Electricity Committee. 36-in. c.i. pipework, chamber and penstock. Form of tender, &c., from Mr. H. Bell, city electrical engineer and manager, Electricity Works, Sculcoates Lane, Hull.

India.—April 30th. India Store Department. 22,000-V cables. (April 2nd.)
May 7th. 15 motor coach underframes and bodies, 30 motor bogie trucks. (March 12th.)
May 14th. Three 5-kW oil engine-driven generator sets, one switchboard, and two pumping sets.*

Irvine (Ayrshire).—April 12th. Town Council. Electric lighting installation at 25 blocks, consisting of 100 houses. Plans from Mr. Robert Frew, architect, 3, High Street, Irvine.

London.—Hammersmith.—April 14th. Electricity Department. H.p. insulated cables, air-cooled and oil-cooled transformers, and h.p. sub-station switchgear. (April 2nd.)

Manchester.—April 13th. Tramways Committee. Copper, silicum, and cadmium bronze trolley wire. Forms of tender from Mr. H. Mattinson, general manager, 55, Piccadilly.

Middlesbrough.—April 16th. Electricity Department. Six or 12 months' supply of cables and 12 months' supply of meters. (March 26th.)

New Zealand.—June 21st. Auckland Electric Power Board. L.p. insulators, &c.*
Wellington.—May 12th. Post and Telegraph Department. 18 switchboards.*

Perth.—April 12th. Electricity Department. One water-tube boiler, capacity 27,000 lb. per hour. (April 2nd.)

Salford.—Corporation Gas Department. One 5-cwt. electric passenger lift at Bloom Street offices. Form of tender from Gas Engineer, Gas Offices, Bloom Street.

Southend-on-Sea.—April 19th. Electricity Department. 1,450 current limiters. (April 2nd.)

Spain.—Madrid.—May 9th. Compania de los Caminos de Hierro del Norte. Overhead line, converting sub-stations, locomotives and motor coaches for the electrification of the lines from Barcelona to Manresa and San Juan de las Abadesas in one contract. The constructors are to obtain as many of their supplies from Spanish industries as possible.—*Reuter's Trade Service* (Madrid).

Stoke-on-Trent.—April 13th. Electricity Department. 12 months' supply of mains and cables, a.c. and d.c. meters, sub-station switchgear, and static transformers. (March 26th.)
April 12th. Gas Committee. Electrical and other machinery, gas engine and dynamo. Contract No. 35. Particulars (20s.) from the Chief Gas Engineer, Gas Works, Etruria, Stoke-on-Trent.

Walthamstow.—April 13th. Electricity Department. Steel overhead bunkers and boiler-house buildings; and coal- and ash-conveying plant. (March 12th.)

Warrington.—April 26th. Electricity and Tramways Committee. L.p. paper and lead-covered cables. (See this issue.)

Waterford.—May 12th. Electricity Department. Two 250-kVA, 3-phase alternators direct coupled to heavy oil engines, e.h.p. mains and l.p. underground distribution system, transformer kiosks, pillars, street lighting services, l.p. overhead distribution system, &c. (See this issue.)

Westhoughton (near Bolton).—April 14th. Urban District Council. Metallic-filament lamps required during year ending March 31st, 1927. Form of tender, &c., from Mr. G. Hayes, surveyor, Council Offices.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Barking.—Electricity Department. Accepted:—
L.p. switchgear.—Edison Swan Electric Co., Ltd.

Belfast.—Corporation Tramways. Accepted:—
Incandescent lamps.—Edison Swan Electric Co., Ltd.

Bury.—Town Council. Accepted:—
Electric lighting installation, Fishpool housing scheme.—Direct Electric Service, Ltd.
Coal for the electricity works.—Wigan Coal & Iron Co., Ltd.

Cardiff.—Electricity Committee. Accepted:—
10,000-kW turbo-alternator (£31,301).—Fraser & Chalmers Engineering Works (General Electric Co., Ltd.).
Condensing plant (£6,791).—Cole, Marchent & Morley, Ltd.
Dust collectors (£1,600).—Davidson & Co., Ltd.

Hastings.—Town Council. Accepted:—
Electrical cooking apparatus for White Rock Pavilion (£811).—Jackson Electric Stove Co., Ltd.
22,000-V, 3-phase overhead lines and cables (£26,554), e.h.p. and l.p. underground cables (£24,658).—W. T. Glover & Co., Ltd.

Hull.—The City Council, to whom the Telephones Committee had referred the selection of tenders for telephone equipment, accepted the lowest British offers in preference to German tenders, which were stated to be 48 per cent. cheaper. The contracts were awarded to Messrs. W. T. Glover and Co., Ltd., the Union Cable Co., Ltd., and Bullers, Ltd.

Telephones Committee. Accepted:—
Dial switches (£146).—Siemens Bros. & Co., Ltd.
Wall telephones (£174).—British L. M. Ericsson Mfg. Co., Ltd.

Leeds.—Tramways Committee. Accepted:—
Traction lamps for car lighting for 12 months.—Siemens & English Electric Lamp Co., Ltd.

London.—Admiralty.—Accepted:—
Switchboard for Devonport Dockyard.—Edison Swan Electric Co., Ltd.

Stepney.—Electricity Supply Committee.
Two 150-kVA transformers (£348).—Hackbridge Electric Construction Co., Ltd. (accepted).
100 single disconnecting boxes (£115).—W. Lucy & Co., Ltd. ((recommended).
50/TC/C disconnecting boxes (£107).—Universal Electrical Manufacturing Co. (recommended).
Cables for 12 months (£27,611).—W. T. Henley's Telegraph Works Co., Ltd. (recommended).
3,000 maximum demand indicators.—Reason Manufacturing Co., Ltd. (recommended).

Manchester.—Electricity Committee. Accepted:—
Cable.—Hackbridge Cable Co., Ltd., and Callender's Cable & Construction Co., Ltd.
Equipment of louvre doors for cooling tower at Stuart Street.—Clyne Engineering Co., Ltd.
E.h.p. switchgear for Oldham Road a.c. sub-station.—A. Reyrolle & Co., Ltd.
Refractor street lanterns.—General Electric Co., Ltd.; Wardle Engineering Co., Ltd.

Tramways Committee. Accepted:—
Motor controller spare parts.—British Thomson-Houston Co., Ltd.; General Electric Co., Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
Tram rail bands.—T. Bolton & Sons, Ltd.; Forest Clay Electric Co., Ltd.

Housing Committee. Accepted:—
Electric light installation at Moston and Burnage estates.—Mr. J. V. Pyatt.

Margate.—Town Council. Accepted:—
Wiring and fitting 72 houses for electric light (£4 7s. 6d. per house).—W. J. Cannon & Co.

Research in Australia.—Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, reporting to the Australian Federal Government as special commissioner, recommends the development of the Science Institute into an important department resembling the British Research Departments and co-operating with them. The annual cost, which would begin at £40,000, would rise to £100,000, says the *Daily Mail*. Sir Frank Heath suggests the appointment of a scientific expert on the staff of Australia House in London, and thinks that the recent creation of a research committee of the British Cabinet as a civil counterpart of the Imperial Defence Committee makes such an appointment particularly necessary.

Forthcoming Events.

Electrical Power Engineers' Association.—Friday, April 9th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 7 p.m. Lecture on "Boiler-house Plant Developments in Association with Powdered Fuels," by Mr. F. H. Rosencrants.

Diesel Engine Users' Association.—Friday, April 9th. At Caxton Hall, Westminster, S.W. Paper on "Industrial Combustion Engines," by Mr. W. A. Tookey.

Chief Technical Assistants' Association.—Saturday, April 10th. At Holborn Restaurant, W.C. At 6.45 p.m. Annual dinner.

Society of Engineers.—Monday, April 12th. At Burlington House, W. At 5.30 p.m. Paper on "An Inquiry into the Ugliness of Engineering Structures," by Mr. H. B. Creswell.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, April 12th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "The Linking Together of Wireless and Wire Communication Systems," to be opened by Capt. P. P. Eckersley.

(Wireless Section).—Wednesday, April 14th. At the Institution, Victoria Embankment, W.C. At 6 p.m. Paper on "The Rugby Radio Station of the British Post Office," by Mr. E. H. Shaughnessy.

(North-Eastern Centre).—Monday, April 12th. At Armstrong College, Newcastle-on-Tyne. At 7 p.m. Lecture on "Some Impressions of Chicago and U.S.A.," by Mr. C. Vernier.

(Scottish Centre).—Tuesday, April 13th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "The Design of Electrical Plant, Control Gear, and Connections for Protection Against Shock, Fire, and Faults," by Mr. H. W. Clothier. Annual general meeting.

(Western Centre).—Monday, April 12th. At University College, Exeter. At 5.45 p.m. Lecture on "Electro-Farming: or the Application of Electricity to Agriculture," by Mr. R. B. Matthews.

(South-Midland Centre).—Wednesday, April 14th. At the University, Birmingham. At 7 p.m. Discussion on "The Government Electricity Bill."

Institution of Civil Engineers.—Tuesday, April 13th. At the Institution, Great George Street, S.W. At 6 p.m. Paper on "The Influence of Electric Welding in the Design and Fabrication of Plant and Structures," by Mr. J. N. Reeson.

Wednesday, April 14th. At 6 p.m. Informal meeting. Discussion on "The Young Engineer: His Training and Prospects," to be introduced by Mr. G. W. Tripp.

Radio Society of Great Britain.—Wednesday, April 14th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6 p.m. Informal meeting.

Institution of Engineers-in-Charge.—Wednesday, April 14th. At St. Bride Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Modern Electric Wiring," by Mr. H. D. Wilkinson.

Saturday, April 17th. Social dance.

Meter Engineers' Technical Association.—Thursday, April 15th. At Anderton's Hotel, Fleet Street, E.C. At 7.30 p.m. General meeting.

Junior Institution of Engineers.—Friday, April 16th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Automobile Lighting, Starting, and Ignition," by Mr. T. L. Allison.

Institution of Mechanical Engineers.—Friday, April 16th. At the Institution, Storey's Gate, S.W. At 6 p.m. Paper on "The Modern Development of Paper-mill Plant," by Mr. W. Worby Beaumont and Mr. L. N. Burt.

Salford Technical and Engineering Association.—Saturday, April 17th. At the Royal Technical College. At 7 p.m. Paper on "Switchboard Instruments," by Mr. A. H. Higgs.

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, April 17th. At the South Wales Institute of Engineers, Park Place, Cardiff. At 6 p.m. Lecture on "Auto-Synchronous Motors," by Mr. E. E. Tasker.

Notes.

Royal Air Force Cadetships.—The Air Ministry announces that the next examination of candidates for entry as flight cadets to the Royal Air Force Cadet College, Cranwell, in September, 1926, will begin on June 22nd, when not less than 35 cadetships will be offered. Forms of entry, obtainable from the Secretary, Civil Service Commission, Burlington Gardens, W.1, must be sent in not later than May 6th. Facilities are given to R.A.F. officers to specialise in, among other subjects, engineering and wireless telegraphy.

Lecture.—On Monday next, under the auspices of the Brighton and Hove Health and Food Reform Society, at the Hove Town Hall, Mr. H. G. Massingham will give a lecture on "The Past and Future Developments of Electricity and its Bearing on Pure Light, Pure Air, Pure Food and Health."

The Volta Centenary Celebrations. — Great preparations are being made in Italy to commemorate next year in suitable form the centenary of the death of the great Italian scientist, Alessandro Volta. All the leading scientific and technical associations are joining together in organising a comprehensive programme which will comprise, among other items, International Congresses on Physics, Telegraphy, and Radio Communication, while an International Exhibition of Electrical Communications is to be held in Como.

Appointments Vacant.—Three car-shed foremen (Rs. 650-10-850 per mensem) for the electrified services of the Indian State Railways. General assistant and draughtsman for the Newark-on-Trent Electricity Department. Lecturer in Electrical Engineering for the Bradford Technical College. Assistant engineer for extension work (£504) (temporary), and Draughtsman (£300) (temporary) for the Dublin Corporation Electricity Department. (See our advertisement pages today.)

Stockport Electricity Works.—OPENING OF EXTENSIONS.—A civic inspection of the new generating plant at the electricity works of the Stockport Corporation took place on Wednesday, March 31st, when the 12,000-kW turbo-alternator set, built by the English Electric Co., Ltd., was inaugurated. The visitors were received by Mr. Ralph Lomax (whose connection with the department dates from 1902 and who has been the borough electrical engineer since 1906) and his deputy, Mr. R. H. Lee, who explained the details of the plant. The plant includes three 5,000-kW turbines, one of 5,500 kW, and the new turbo-alternator, which is capable of a continuous output of 12,000 kW at 0.8 p.f., at a pressure of 6,000 volts, three-phase, 50 cycles, and runs at a speed of 3,000 r.p.m. New main switchgear is under erection, consisting of a remotely-controlled electrically-operated cubicle switchboard, supplied by the English Electric Co., Ltd. A Tudor battery of 3,000 ampere-hours has been installed. There are also two 1,500-kW and two 1,000-kW rotary converters of the English Electric Co.'s construction and one 1,000-kW La Cour converter by Messrs. Bruce Peebles & Co., Ltd.

A notable feature in the history of the Stockport electricity supply has been the way the capital charges have been kept down, with the result that last year there was a gross profit of 10.94 per cent. upon the capital expended and of 17.97 per cent. upon that outstanding. There are 7,714 consumers, and although the town has suffered from the prevailing depression in the cotton trade, the authorities are optimistic with regard to the future, and have provided plant to meet the coming needs. The cost of the new turbo-generator, new boilers, and structural alterations, will be about £100,000, and the cost per kW of plant installed works out at a little over £12. When the site is developed to its present accepted limits of 50,000 kW installed capacity it should work out at £10 per kW. During the last two years the supply of electricity in bulk has been extended to the Hazel Grove and Bramhall Urban District Council and the Bredbury and Romiley U.D.C., whilst supplies to the authorities at Marple and New Mills are under consideration.

After the inspection of the new plant, Councillor James Harrison, as chairman of the Electricity Committee, christened the 12,000-kW turbo-generator the "George Ball," in honour of the first chairman of the Committee, and then started the machine. Subsequently luncheon was served at the Town Hall, when the Mayor (Councillor J. Greenhalgh, J.P.) presided over a full attendance of leading public men.

Mr. P. H. Symonds, in proposing "Success to the Stockport Electricity Undertaking," said that the Stockport station was the first of its size in order of merit according to the Electricity Commissioners. With regard to the Electricity Bill he hoped there would be as little control as possible. The electricity undertaking wanted to develop on sound commercial lines. Stockport enjoyed low capital charges, and tribute should be given to the sound commercial instincts of their electrical engineer, Mr. Ralph Lomax.

Alderman George Ball, who until recently was chairman of the undertaking from the first, replied, and said they would be able to generate a cheap and abundant supply of electricity for a long time to come. He eulogised the services of Mr. Lomax, whose advice had been most useful to the Committee.

The Optical Convention.—At the meeting of the Scientific and Technical Circle of the Institute of Journalists on March 29th, presided over by Mr. L. Gaster, a survey of the aims and objects of the Optical Convention, to be held at the Imperial College of Science and Technology from April 12th to 17th, was given. The British optical industry has for long had to contend with great difficulties, but from the scientific standpoint it is an exceedingly important one, and the vital consequence of "optical munitions" during the war was strikingly demonstrated. Recognition of its national value is afforded by the fact that the Prime Minister, Mr. Stanley Baldwin, is to open the Convention. At the meeting of the Circle, Mr. Frank Twyman, F.R.S., gave a good summary of the variety of apparatus, cameras, telescopes, microscopes, projectors, surveying instruments, &c., of which lenses form a part. Journalists should not forget that every process block also requires the use of an optical lens. Many of these instruments have done invaluable service in opening up new fields of knowledge. Professor F. J. Cheshire, in the course of an account of some experiences as director of the Department of Optical Munitions during the war, referred to their applications in range-finders. Generally speaking, the optical industry, like illuminating engineering, finds its main justification in the statement that before one can act one must *see*.

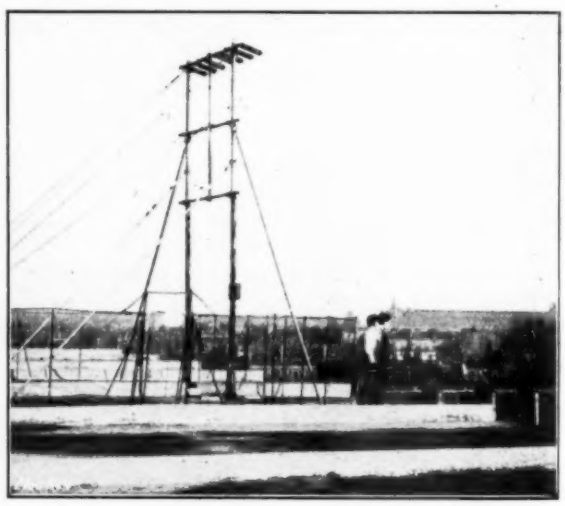
At the Convention there will be many papers and exhibits of scientific interest. Public interest is to be aroused by many ingenious optical illusions and entertainments, some of which were described at the meeting by Sir Richard Paget. One of the most attractive of these is the "Fairy Theatre," wherein fairy figures only 6 inches high will perform; these dramatic performances have been arranged with the assistance of Mr. Kenneth Barnes, M. Komisarjevsky and the students of the Royal Academy of Dramatic Art. Amongst the exhibitors will be Messrs. C. A. Parsons & Co., Ltd. (searchlight reflectors), Henry Hughes & Son, Ltd. (compasses, sounding machine), the Cambridge Instrument Co., Ltd. (pyrometers, photometers, &c.), the Foster Instrument Co. (pyrometers), the Thermal Syndicate, Ltd. (mercury pumps, wireless valves in fused quartz, &c.); and the National Physical Laboratory, the Imperial College technical optics department, the Illuminating Engineering Society, and other scientific bodies will be represented in the Experimental and Research Section.

Nitrogen Fixation.—Speaking at the Princeton Chemical Club, U.S.A., Dr. Frederick G. Cottrell, chairman of the Fixed Nitrogen Research Laboratory at Washington, estimated that approximately 44 per cent. of the world's inorganic supply of nitrogen would be obtained this year by atmospheric fixation, against less than one-fourth that amount

before the war. While the 10 per cent. made in this way before the war was almost wholly by the arc and cyanamide process, nearly 70 per cent. of this year's fixation will be through the direct synthesis of ammonia.

An Electric Railway Project.—It is stated that the Spanish Northern Railway Co. proposes to convert to electric traction the lines between Barcelona and Manresa, and Barcelona and San Juan de las Abadesas. Offers for the delivery of the material, including the rolling stock, and its erection, are to reach the Compania de los Camions de Hierro del Norte, Estacion del Norte, Madrid, by May 9th. Further information on the requirements and the conditions may be obtained from the electrification bureau of the company in Madrid.

A French Broadcasting Station.—One of the Continental broadcast radio-telephone transmitting stations which English listeners have become accustomed to hear in this country is that of L'Ecole Supérieure des Postes et des Télégraphes at Paris. It is known by its call signal FPTT, its nominal wavelength being 458 metres and power 500 watts; part of the transmitting apparatus is illustrated in one of the photographs here reproduced, whilst the other shows one of the aerial masts



Part of Transmitter, and Roof Aerial Mast, of L'Ecole Supérieure Broadcasting Station, Paris.

on the flat roof of the Central Telegraph Office building. The height of the mast may be gauged by comparison with the two men standing nearby and the arrangement of the aerial wires themselves will be noted with interest, differing as it does from that in use in this country. It is one of the three well-known Paris stations, and is housed in the training college itself, in the Rue de Grenelle. From small beginnings it has come to be one of the best known in Europe, and now transmits each evening from 8.30 p.m. Notwithstanding its small power its signals are received well within a radius of 1,200 miles, and are heard regularly over the whole of Western Europe from Sweden to Spain, as well as in Northern Africa.

Electric Dredges for Mining. — We learn that five electrically-operated mining dredges, to be used in the mining of platinum, are to be installed for the Platinum Trust of the Soviet Government of Russia for service in the territory of the Ural Mountains. They will be supplied from transmission systems at 40,000 and 10,000 V, 3 phase, 50 cycles, the working pressure being 440 V. The equipment is to be supplied by the G.E.C., America.

Electrical Association for Women.—On March 26th, a party of members of the Association paid a visit to the demonstration rooms and laboratories of Holophane, Ltd. Mr. L. M. Tye gave a short review of "Scientific Progress in Illuminating Engineering." Special colour demonstrations were made and films were exhibited showing shop window and interior lighting. Mr. L. Gaster, secretary of the Illuminating Engineering Society, and Mr. Loveday (E.D.A.), were with the party.

The first meeting of the Birmingham and Midland Branch of the Association was held at the Council House on March 29th. Professor Burstall, D.Sc., Dean of the Faculty of Science at Birmingham University, pleaded with humour and fervour for a forward movement amongst women towards electrical self-help in the home. He declared that he had himself "spring-cleaned" a room in twenty minutes—with an electric vacuum cleaner. Women should adapt their houses to their own strength, eliminate servants, and acquire good labour-saving devices, thus keeping their houses cleaner and giving themselves time to develop their own lives in other more congenial directions. It was essential that they should understand the assistance that electricity offered.

Mr. E. J. Jennings, secretary of the Electric Supply Department, reported an increase last year of 8,600 consumers in Birmingham, double the increase of the previous year and ten times the annual pre-war increase. He said there was a possibility of the power tariff in Birmingham being reduced to ¾d. (against the present 1¼d.).

Miss Haslett, Director of the Association, said that women must *clamour* for the help electricity could give them in their homes, but first they must understand what they were asking for. To teach this was the mission of the Association.

Cheap Electricity at Southport. — Mr. E. Moxon, A.M.I.E.E., borough electrical engineer to the Southport Corporation, informs us that during the two summer quarters the charge for electricity for heating is to be reduced from 1¼d. to 1d. per unit. The inclusive domestic tariff, made up of a fixed charge of 3s. per scheduled room per quarter, and a running charge of 1d. per unit for all electricity consumed, subject to a minimum charge equivalent to 2s. per scheduled room, has been adjusted by a reduction of the unit charge from 1d. to ½d. per unit, the fixed and minimum charges remaining unchanged. A circular letter that has been sent out to all consumers points out that no one need have coal fires after April 1st, for six months, as electric radiators will give better, cleaner, and more efficient service, whilst cooking can be done in cool comfort, and hot water obtained with immersion heaters. These and many other electrical appliances can be obtained on hire or hire-purchase from the new Corporation showrooms, where demonstrations of electric cooking are given twice a week; the showrooms are kept open till 9.30 p.m. on those occasions. This, we believe, is an excellent way to develop domestic electricity supply.

Institution Notes.

Institution of Fuel Technology.—The first meeting of the Organising Committee of the above Institution was held on March 23rd, when the name of the Institution was definitely confirmed as above. Within the limits of its powers of co-option of additional members, the Committee is extending invitations to other organisations to be represented on it. A sub-committee was appointed to draft the constitution and by-laws. The draft will be considered in detail by the Organising Committee and eventually a copy will be sent in advance to everyone interested for consideration, prior to a second public meeting which will be called to adopt or amend the draft as the potential members may think fit. It is the intention that the new Institution shall be thoroughly representative of every branch of the wide subject of fuel. The support so far received has exceeded all expectations. All communications should be addressed to the Hon. Secretary (pro tem.), Mr. Edgar C. Evans, Caxton House (East), Tothill Street, Westminster, S.W.1.

Institute of Transport.—Circumstances have arisen which necessitate the postponement of the dinner of the Institute, which was to have been held on Wednesday, April 21st.

The I.M.E.A. Convention, 1926.—In the official preliminary programme of the Convention, abstracted in our last issue, it was stated that a paper on "Industrial Heating" would be read by Mr. A. P. M. Fleming. We now learn that this will be a joint paper, his collaborator being Mr. J. H. Crossley, Wh.Ex., B.Sc., industrial heating expert to the Metropolitan-Vickers Electrical Co., Ltd.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements).

Halifax Corporation Tramways Committee received 33 applications for the post of tramways manager, vacated by Mr. B. HALL, who goes to Portsmouth. The list was reduced to five.

The appointment of Mr. F. E. SPENCER, A.M.I.E.E., as Borough Electrical Engineer to the Birkenhead Corporation has been confirmed.

Mr. A. H. DARKER, of Messrs. J. Stone & Co., Ltd., who is on a business tour of the world, has concluded his tour of India, Burma and Ceylon, and was, according to advice dated February 20th, on his way to Australia and New Zealand.

Dr. H. R. WRIGHT, who succeeds the late Mr. Francis Hird as managing director of Siemens Brothers & Co., Ltd., was born in 1877. From early days his father, Mr. Henry S. Wright, of London, who was connected with chemical works in Manchester and Widnes, interested his son in scientific matters, encouraging him to make experiments in chemistry and physics. As evidence of the interest thus evoked, he thought out and himself constructed a coin feed apparatus when only about 10 years old. He commenced his scientific and engineering training at the Regent Street Polytechnic,

Dr. H. R. Wright.

London, under Professor H. Spooner, and continued at the Technical High Schools at Munich and Karlsruhe under Arnold, and at the University of Munich, where he took his doctor's degree at the early age of 21. Before returning to England, he acquired practical knowledge of Continental dynamo design at Vienna under the well-known Austrian designer, the late Professor Pichelmayer, and then obtained an appointment with Siemens Brothers & Co., Ltd., at Stafford. When the company decided to interest itself in the field of telephony and to extend its works at Woolwich, he joined, in October, 1907, the new organisation at the request of his former chief, Mr. F. Hird, at one time works manager of the Stafford works of Siemens Brothers Dynamo Works, Ltd., who had taken charge at Woolwich of this new work. During the 24 years of his service with the Siemens undertakings, he has been successively concerned with the activities of nearly every one of the departments, from designing large generator units to the introduction of mass production of small dry cells. During later years he was drawn more and more on to the administrative side, and in 1925 was appointed general manager to the company.

Mr. J. S. PECK, M.I.E.E., Fellow Amer.I.E.E., chief electrical engineer of the Metropolitan-Vickers Electrical Co., Ltd., sailed on April 2nd for New York, where he will attend, as one of the British representatives, the meetings of the International Electrotechnical Commission.

Mr. ALAN A. CAMPBELL SWINTON, F.R.S., M.I.E.E., &c., is retiring from the electrical and general consulting engineering practice that he has carried on for the past 37 years at 66, Victoria Street, Westminster, S.W.1. He will continue special consulting work, also his electrical and engineering directorates and scientific activities, from his residence at 40, Chester Square, London, S.W.1.

There were 150 applications for the position of charge engineer to Mersey Power Company, and Mr. H. POLLARD, Grad.I.E.E., of South Shore, has been appointed.

On March 31st, Mr. C. FURNESS, borough electrical engineer, Blackpool, was presented by the staff with a portrait of himself. The presentation was made by the Mayor at the annual meeting of the Electricity and Tramways Employés' Institute. Mr. Furness, in acknowledging the gift, gave interesting statistics respecting the great growth that had taken place in the electrical undertakings since his appointment in 1902.

Mr. H. J. NISBETT, for 12 years manager of the Torquay Tramways Co., who has retired, has been presented by the staff and employés with a book-case.

At a meeting of Accrington Corporation, recommended increases to heads of departments, including Mr. A. W. CLEGG, electrical engineer, were negatived. The Electricity Committee recommended that the bonus of Mr. Clegg be increased from £166 to £214, which would have made his total remuneration £914 per annum.

Mr. A. BAXENDALE, who has terminated eight years as depôt superintendent for the Rawtenstall Tramways, and has been appointed rolling stock and works superintendent for the Wallasey Corporation, has been presented with a reading lamp and fountain pen by the staff and employés of Rawtenstall Tramways Department.

The Industrial Australian and Mining Standard states that Mr. R. W. DALTON, H.M. British Trade Commissioner in Australia, who is at present on a visit to New Zealand, will leave there early in April bound direct for London. During his absence, which is expected to be for 12 months, Mr. A. SIMPSON will act as senior Trade Commissioner. Mr. Simpson will remain in Sydney. The office in Melbourne will be in charge of Mr. F. W. COLMAN.

Obituary.—MR. G. S. CORLETT.—With further reference to the career of the late Mr. G. S. Corlett, the moment is appropriate for reminding our readers that he was one of the pioneers of the application of electricity to the coal-mining industry, and at a comparatively early date foresaw the great developments which have taken place in the mining electrical world. We understand that he was actually responsible for the installation of the first three-phase motor in any mine in this country. In March, 1923, Mr. Corlett had a serious breakdown in health, from which he never recovered. In spite of this handicap, he continued, almost up to the end of his life, to take a very keen interest in all that concerned the electrical world.

MR. P. DICKS.—The death has taken place suddenly, at the age of 66 years, of Mr. Philip Dicks, head of the firm of Dicks, Ltd., electrical engineers, of Winchester. Mr. Dicks was a member of the committee of the Hampshire and District Branch of the Electrical Contractors' Association.

HERR A. THYSSEN.—The death is reported of Herr August Thyssen, the celebrated German steel magnate, at the age of 85 years. He started with a very small capital, and in course of time amassed an immense fortune from industry, giving employment to 50,000 workmen. He continued business personally at his office right to the end.

Wills.—The late Mr. LEONARD G. TATE, of the Electrical Contractors' Association, left £4,133 gross and £2,046 net personalty.

Sir THOMAS D. G. CARMICHAEL, Baron Carmichael of Skirling, a director of a number of companies, including the British Thomson-Houston Co., Ltd., and the Lanarkshire Tramways Co., Ltd., left £35,005 gross and £31,781 net personalty.

New Companies Registered.

City and General Radio Co., Ltd. (212,819).—Private company. Registered March 30th. Capital, £250 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in wireless and electrical apparatus and goods, &c. The subscribers (each with one share) are:—C. L. Bradley, 48, Norland Square, Holland Park, W.11, radio engineer; T. H. Smith, 25, Addison Way, Golders Green, N.W.11, merchant. The subscribers are to appoint the first directors. Solicitors: Lloyd, Richardson and Co., 115, Shaftesbury Avenue, W.C. Registered office: 79, Cannon Street, E.C.

Essex Radio Supplies, Ltd. (212,892).—Private company. Registered March 31st. Capital, £1,500 in £1 shares. Objects: To carry on the business of engineers, advisers, experts, consultants and contractors in connection with wireless telephony or telegraphy, &c. The subscribers (each with 5 shares) are:—A. Reich, 65, Lordship Road, N.16, merchant; Rae Reich, 65, Lordship Road, N.16, clerk. A. Reich is permanent director. Qualification, £5 shares.

Quain Sunlight Lamps, Ltd. (212,795).—Private company. Registered March 29th. Capital, £5,000 in 3,500 8 per cent. preference and 1,500 ordinary shares of £1 each. Objects:—To acquire any interests in patents relating to medical, surgical, therapeutic, hygienic, or general appliances of any kind, particularly electric and other lamps of all kinds, for producing light and heat, &c. The subscribers (each with one ordinary share) are:—P. R. Pitts, 28, Merton Road, Walthamstow, E.17, solicitor's managing clerk; E. Brooks, Harrow Cottage, Knockholt, Kent, solicitor's managing clerk. The subscribers are to appoint the first directors. Qualification, 100 ordinary shares or stock. Solicitors: Roche, Son & Neale, 1, Church Court, Old Jewry, E.C.2. Registered office: 17, Victoria Street, Westminster, S.W.1.

Sign Construction Co., Ltd. (212,809).—Private company. Registered March 29th. Capital, £1,000 in 2s. shares. Objects: To carry on the business of electricians, manufacturers of, and dealers in electrical and other advertisement signs, indicators, and apparatus, to construct, lay down, and fix all necessary cables, wires, lines, accumulators, lamps, and works, &c. The directors are:—H. S. Coleman, 5, Winchester Street, Victoria, S.W.1, electrical engineer; C. E. H. Fitch, address not stated; S. H. Instone, address not stated.

Alton District Electricity Co., Ltd. (212,738).—Registered March 27th. Capital, £5,000 in £1 shares. Objects:—To carry on in the United Kingdom or elsewhere the business of an electric light and power company in all its branches. Minimum cash subscription, 500 shares. The first directors are:—K. A. S. Moncrieff, "The Clough," Oxted, engineer; E. H. F. Reeves, Field House, Friern Park, North Finchley, N.12, director of a public company; Sir Home Gordon, Bt., 44, Park Lane, W.; J. Eustace, "Elmhurst," London Road, Chelmsford, engineer; Lt.-Col. G. C. Stowell, "Glendale," Church Road, Hanwell, secretary of public companies. Qualification, £100. Remuneration as fixed by the company. Solicitors: Wilkinson, Bowen, Jackson & Curran, 34, Nicholas Lane, E.C.4. Registered office, 484, Salisbury House, London Wall, E.C.2.

Official Returns of Electrical Companies.

Scammell & Abbott, Ltd.—First mortgage debenture dated March 17th, 1926, to secure £200, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. W. Scammell, 20, Primrose Lane, Hall Green, Birmingham.

C. T. Briscoe & Son, Ltd. (173,926).—Capital, £5,000 in £1 shares. Return dated March 8th, 1926. 2,000 shares taken up. £110 paid. £1,890 considered as paid. Mortgages and charges, nil

H. P. Electrical Co., Ltd. (187,715).—Capital, £1,000 in £1 shares. Return dated September 30th, 1925 (filed February 18th, 1926). 654 shares taken up. £654 paid. Mortgages and charges, nil.

Reflek Radio Co., Ltd.—F. Davies, of 245, Kingsland Road, E.2, was appointed receiver on March 18th, 1926, under powers contained in debentures dated December 22nd, 1925.

Flather & Co., Ltd. (74,602).—Capital, £20,000 in £1 shares. Return dated November 10th, 1925 (filed March 20th, 1926). 11,044 shares taken up. £9,544 paid. £1,500 considered as paid. Mortgages and charges, nil.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

Marconi International Marine Communication Co., Ltd.

Mr. F. G. Kellaway (deputy chairman and managing director) presided at the annual meeting on March 31st, in the absence of the chairman, Senatore G. Marconi. In presenting the report, Mr. Kellaway said that the remarkable increase in the net profit—over £35,000—was due to the drastic administrative economies which had been effected and to the settlement of war-service claims against the Italian Government. The work of retrenchment was still proceeding and further reductions should be effected during 1926. The directors considered it unwise to pay too large a dividend and it was their intention to build up a substantial reserve for obsolescence and to carry forward a greatly increased amount. They intended to maintain their predominant position by keeping all their plant up to date. While the net profit had shown a substantial increase, it had not regained the level of some previous years; that was due to the continued depression in the shipping industry. Nearly 200 ships per annum had had to be dismantled with a consequent loss of business to the company. There had been a slight improvement, particularly on the Clyde, but it would be some time before the new tonnage would have its effect. They could therefore not look forward to any considerable expansion in new business during the current year, but they must look for the maintenance of their present favourable position and to a continuation of their retrenchment policy. The chairman then proceeded to review the accounts (*vide* Elec. Rev., March 26th, p. 509). Referring to the strike of wireless operators, Mr. Kellaway said that after three months the men had agreed to negotiate. It was hoped that the result would be to place the relations of the operators and the companies on a foundation of mutual confidence and respect. On the technical side, great improvements had taken place in the Marconi system of direction finding. An increasing number of shipowners were realising the value of the direction finder and many reports praising the instrument had been received. During 1925 the Marconi public-address system had been applied in ships to relay the music of ships' bands, &c. Mr. Ogle, the secretary of the company, had left to take up a position with Marconi's Wireless Telegraph Co., Ltd., and Mr. B. O. Collis, formerly assistant secretary, had taken his place. The report and accounts were adopted.

British Aluminium Co., Ltd.

The annual meeting was held on March 30th, Col. S. H. Pollen, C.M.G., presiding. In moving the adoption of the report, the chairman said that the net profit for the year had amounted to £550,434, as against £491,973 for the previous 12 months, and the trading profit was £517,105, as compared with £476,709, an increase of £40,396. The past year had been a favourable one for the company. They were fortunate in having an ample supply of water for the hydro-electric installations, and the output of metal from the works showed a record tonnage. Trading conditions continued to be satisfactory, and the demand for their products had, on the whole, been well maintained. Prices remained fairly steady and favourable. As the result of research work, continuously carried out by the staff, there had been improvement in methods of production, which had gone far to counterbalance the prices of raw materials and other charges incidental to production, which showed no indication of decrease. The development of non-corroding alloys had led to a marked increase in the use of aluminium in marine construction, and the textile industry was also adopting the metal more extensively. Among the newer uses, particular interest attached to aluminium alloy road wheels. The electrical industry year by year augmented its demands for aluminium for transmission lines, bus-bars, and other applications. The proposals of the Government for the more general distribution of electricity throughout the country should, if proceeded with, lead to a greater extension of overhead transmission lines, and they hoped that the aluminium industry would benefit from that development. The world's annual use of aluminium to-day in tonnage was approaching double the consumption of tin, and the world consumed in greater quantity only three other non-ferrous metals, namely, copper, lead and zinc. During the year they had added to the capacity of the alumina plant at Burntisland, and had found it necessary to further expand their rolling mills. Considerable extensions had been carried out at the works in Norway, in which they had a part interest, and the benefit from those would begin to accrue during the current year in the form of an increased supply of metal. Substantial progress had been made in the carrying out of the civil engineering portion of the Lochaber water-power scheme. The principal work to be undertaken was the driving of the main tunnel from Loch Treig to Fort William. That tunnel would be 16 ft. in diameter, and would have a total length of 15 miles. To enable this work to be tackled on a broad front and to be pushed with energy, it was necessary to carry out preliminary and temporary works of considerable magnitude, including the construction of a temporary hydro-electric station which involved the driving of a tunnel over a quarter of a mile long and the installation of plant of 4,500 h.p. capacity to provide power for the whole of the constructional work. Twenty-four miles of h.p. transmission lines had been erected, connecting up motor-driven air-compressing plants. Those various temporary works had been carried out by the contractors, Balfour, Beatty & Co., Ltd., with great expedition, and were now practically completed, and tunnelling operations were proceeding satisfactorily. It was a matter of great satisfaction to the directors to be able to submit accounts which exhibited still further improvement in the affairs of the company, and to be in a position to recommend, in addition to a dividend at the rate of 10 per cent. per annum, a bonus of 2½ per cent. As to the future, they would not expect him to prophesy, but he could say that up to the present no disturbing factor was evident. They could not expect all conditions to be always favourable, but they had no reason to anticipate that the results of the year now entered upon would prove otherwise than satisfactory. The report and accounts were adopted.

Llanelly and District Electric Supply Co., Ltd.

The annual meeting was held on March 30th. Mr. A. R. Holland, the chairman, in presenting the report, said that although the number of customers had increased during the year, the depression in the district had impeded the company's normal progress. The directors had adopted a progressive policy, laying a network of mains in districts which were expected to show future development. Given an improvement in conditions, there was little doubt that the company's business would show a substantial increase. Referring to the new Electricity Bill, Mr. Holland said that he did not think that the measure would encourage the development and use of electricity or cheapen the cost of generation and distribution. It was obvious that the provisions of the Bill would need considerable amendment before they could be held to deal fairly with the rights of private enterprise, which had done so much to further the development of the industry. There were indications of a slight improvement of trade in the company's area, but there were also considerable difficulties to be surmounted. The purchase of the property of the Gorseinon Electric Light Co., Ltd., had been completed; the undertaking would prove a satisfactory addition to the company's assets. The transport section of the business had been adversely affected by uncontrolled omnibus competition. Debenture stock and preference shares had been issued during the past year, and further capital was necessary to meet extra expenditure, including the connecting-up of a large colliery undertaking. The directors regretted that the ordinary dividend was lower, but they considered that they were adopting the best course.

British L. M. Ericsson Mfg. Co., Ltd.

The annual meeting was held on March 30th under the chairmanship of Mr. W. M. Crowe. In presenting the report, the Chairman mentioned that 1925 had been a record year for the company. There were definite signs of an improvement in industry and that the period of trade stagnation was passing. As indicating the amount of potential business which existed in this country, Mr. Crowe said that Great Britain was fourteenth in the list of the world's telephone users. There had been an enormous expansion in the United States and Canada, largely on the automatic system, and most progressive countries were developing along that line. At the Beeston works they had an efficiently managed automatic telephone department which would be capable of undertaking exchange work of almost any dimensions. The report and accounts were adopted, and at a subsequent extraordinary meeting an increase in the capital of the company to £500,000 was sanctioned. It is proposed to issue about 100,000 preference shares of £1 each for cash, and, later, to capitalise part of the reserve and issue ordinary shares to the present shareholders. It is also intended to raise the preference dividend from 6 to 7 per cent.

South London Electric Supply Corporation, Ltd.

Sir Harry Renwick, K.B.E., presided at the annual meeting on March 30th, and in the course of his speech, said that the results for the past year were satisfactory from every point of view. He quoted figures to show the progress which had been made since 1918 when the company commenced to take a partial bulk supply from the County of London Electric Supply Co. The dividend in 1918 was 5 per cent.; 15 per cent. had been paid for the last three years. He considered that those figures were eloquent. Referring to the reorganisation of supply in the

London area, Sir Harry said that the companies concerned hoped to be able to deal with the matter during the current year. In the meantime, the company was arranging to take a greater bulk supply from the County of London Co. They were of the opinion that they would not be affected by the Government's Electricity Bill, but the directors were watching the company's interests. The prospects for the current year were favourable, and the progress in new business was so far satisfactory. The report and accounts were adopted.

Electric Supply Corporation, Ltd.—The gross earnings for 1925 amounted to £101,024 and the sum taken into net revenue account to £46,971. After meeting charges, including the preference and interim ordinary dividends, there remains a surplus of £36,858. It is proposed to transfer £5,000 to general reserve, and £12,000 to depreciation, to write off balance of expenses of share issue, &c., £2,000, to write off £1,058, the cost of obtaining Orders for Hitchin and Exmouth, and to pay a final dividend of 6 per cent. on the ordinary shares (making 10 per cent. for the year), together with a bonus of 1 per cent. This will leave £6,300 to be carried forward. The amount of energy sold fell from 9,397,486 to 8,762,994 kWh. The report states that the Hendon Electric Supply Co. has paid a dividend of 15 per cent., but the Dumbarton Tramways Co. has again been unable to make any distribution. Meeting, April 15th.

Bath Electric Tramways, Ltd.—The annual meeting was held on March 31st. In the course of his speech the chairman (Mr. E. H. R. Trenow) said that the accounts showed a slight general improvement. The fare arrangement under which the company operated, somewhat heavily penalised it. In addition to the fact that while labour and materials cost about 100 per cent. more than in pre-war days and the fares were only about 40 per cent. higher, the company had to provide for renewals out of revenue each year. During 1925 nearly two miles of track had been overhauled and reconstructed and some of the loops had been extended. The number of passengers carried showed a satisfactory increase, but the average revenue was lower. So far this year the improvement was being maintained.

A. Reyrolle & Co., Ltd.—The profit for the past year was £70,621 and the addition of £19,206 brought forward gives an available balance of £89,827 (as compared with £82,709 in 1924). The directors recommend that a dividend of 12½ per cent. shall be paid on the ordinary shares (as in 1924), that £15,000 shall be transferred to reserve, and that £29,873 shall be carried forward. The capital expenditure during the year was £43,355, representing additions to offices, increased storage accommodation, and new machines. The recreation ground has been completed and a sum of £2,038 has been provided out of the year's profits. The work completed during the year was substantially larger than in 1924 and the exports of the company's manufactures continued to increase. The meeting is to be held to-day (Friday).

London Electric Wire Co. & Smiths, Ltd.—Sir George H. Fisher-Smith (chairman) presided at the annual meeting on March 31st, and in moving the adoption of the report and accounts, said that although the past year started with considerable promise there was a distinct slackening off during the course of the year. As a result the company's output had declined and the profit was £5,856 lower than in 1924. With regard to the current year the company was receiving a fair share of orders. If the legislative assistance promised to the electrical industry could be arranged to function quickly, good should result, but the maximum benefit would not be obtained unless individual effort was given full scope and unless there was complete co-operation between the interests concerned.

Lancashire Dynamo and Motor Co., Ltd.—After providing for debenture interest and depreciation, the available balance from 1925 is £20,201, to which is added £204 brought forward, making £20,405. The preference dividend has been paid and it is proposed to distribute 7½ per cent. on the ordinary shares, to transfer £5,000 to reserve and to carry forward £2,147. The report states that the results were again somewhat better than those of the preceding year, and the output was larger. The Company appears to be getting a good proportion of the orders which are being placed. The Crypto agreement has again worked satisfactorily in the interests of both companies.

Bournemouth and Poole Electricity Supply Co., Ltd.—The report for 1925 shows a balance on the revenue account of £153,407, to which is added £10,881 brought forward, making £164,288. After the payment of debenture interest, interim dividends, &c., and transferring £65,000 to general reserve, £25,000 to depreciation, &c., reserve, and £2,500 to staff superannuation reserve, there remains £40,192. It is proposed to pay a final dividend at 5½ per cent. on the ordinary shares (making 10 per cent. for the year), plus a bonus of 4 per cent., free of tax, leaving £10,076 to be carried forward. The capital expenditure during the year was £90,380. The amount of energy sold was 9,715,129 kWh. The meeting is to be held on April 15th.

Waste Heat and Gas Electrical Generating Stations, Ltd.—The annual meeting was held on March 26th, Mr. F. Stirling Newall presiding. In the course of his speech, the chairman said that the accounts were satisfactory. They had expended £1,719 on capital account, the balance of the capital expenditure on the provision of the extension to the Horden power station. That completed their capital commitments, as they had no additional proposals before them at the moment. Their investments had been increased by £10,424, which was invested in Government securities. The company was in a good financial position. The output from the stations was satisfactory, being more than 13 per cent. over the total output in the previous year. Two of the stations had not worked during the latter half of 1925, but in spite of that the aggregate output had gone up, mainly due to the operation of the Horden station extension.

Richmond (Surrey) Electric Light and Power Co., Ltd.—The profit for the past year was £36,239, and the addition of £1,823 brought forward gives an available balance of £38,062. After meeting debenture interest, &c., reserving £2,000 for staff superannuation and £7,250 for depreciation, &c., and transferring £7,000 to general reserve, there remains a balance of £5,763. Out of this the directors recommend the payment of a dividend of 10 per cent. on the old ordinary shares, leaving £2,630 to be carried forward. The amount of energy sold increased to 2,522,274 kWh. During the year an issue of 168,670 ordinary shares of £1 each was made. Meeting, April 15th.

Cork Electric Tramways and Lighting Co., Ltd.—The accounts for 1925 show an available sum of £22,881 (including £7,337 brought forward), after providing for debenture interest, &c., and transferring £4,500 to general reserve, and £15,000 to depreciation and renewals reserve. Interim dividends absorbed £9,613, and it is proposed to pay a final dividend of 3 per cent. (making 6 per cent. for the year) on the ordinary shares, and to carry forward £9,818. The receipts for the year were lower owing to the reduction of charges, a decrease in tramway traffic, &c. Meeting, April 15th.

River Plate Electricity Co., Ltd.—After meeting expenses, the profit for the past year is £47,292, and the addition of £12,169 brought forward makes £59,461. It is proposed to pay a dividend of 11 per cent. upon the ordinary shares (3 per cent. already paid) to transfer £14,701 to general reserve, and to carry forward £7,318. The directors also recommend that £34,701 of the general reserve shall be capitalised and allotted to the ordinary shareholders in the proportion of one to ten. The dividend for 1924 was 10 per cent. The meeting was to be held yesterday (Thursday).

Ransomes & Rapier, Ltd.—In their report for 1925 the directors state that although the results were satisfactory having regard to the state of the engineering industry, they consider that the future presents not a little anxiety. The amount available, including the balance brought forward, is £32,639. A dividend of 7 per cent., free of tax, is recommended on the ordinary shares (as against 12 per cent.), and a balance of £23,231 is carried forward.

South Wales Electrical Power Distribution Co., Ltd.—The balance on working for the past year was £96,762. After providing for debenture interest and depreciation, £7,073 remains. The dividend is to be paid on the 5 per cent. preference shares, and a balance of £807 is to be handed over to the South Wales Power Co. Meeting: April 16th.

South Wales Power Co.—The report for 1925 states that the administration of the undertaking was re-vested in the South Wales Electrical Power Distribution Co., whose report is dealt with above. The company's accounts show a net surplus of £18,441, after meeting debenture interest and preference dividends. It is proposed to put £10,000 to reserve and to carry forward £8,441. It is stated that apart from the adverse conditions prevailing in the area, some time must elapse before the expenditure upon extensions becomes more fully productive. Meeting: April 16th.

Italian Company.—*La Società Ligure Toscana d'Elettricità*, of Milan, reports that during 1925, the output of the company's stations reached a total of 171,094,400 kWh, as compared with 147,974,700 kWh in 1924. The net profit advanced from 10,966,308 to 14,013,131 lire, which enables a dividend of 10 per cent. to be paid. In order to provide for further extensions, the capital of the undertaking is being increased from 80 to 120 million lire.

German Company.—The *North German Cable Works Company*, Neukolln, proposes to carry forward the comparatively small net profit earned in 1925. The directors state that business in the current year has been very satisfactory and shows a considerable improvement over that in 1925.

Belgian Company.—The *Société des Constructions Electriques Belgique* (Liége) reports a net profit of 109,140 fr. for the last financial year, as compared with a loss of 761,303 fr. in 1924.

English Electric Co., Ltd.—The directors announce that, while the profit for 1925 is sufficient to permit of the payment of the full preference dividend, they are unable to recommend any dividend on the ordinary shares. Five per cent. was paid for each of the four preceding years, while in 1919 and 1920 eight per cent. was paid.

J. Stone & Co., Ltd.—The balance from 1925 (including £135,037 brought forward) is £296,115. It is proposed to transfer £130,000 to reserve, to pay a dividend of 2s. per ordinary share, and to carry forward £67,075.

Calcutta Electric Supply Corporation, Ltd.—It is stated in the financial Press that an offer of additional ordinary shares at a price providing a considerable bonus will shortly be made to the existing ordinary shareholders.

Stocks and Shares.

Tuesday Evening.

Holiday influences are very obvious in the Stock Exchange markets. Business became slack and uninteresting after the accumulation of post-orders had been dealt with on Tuesday morning. Prices are not greatly changed from those of a week ago. The principal alteration is a drop of 4s. 6d. in English Electrics, upon the wholly unexpected passing of the dividend.

It had been taken for granted that the English Electric would pay at least 5 per cent. for 1925, the same as in the four previous years. People are unable to account for the directors' decision, and they await, almost impatiently, the report and the meeting, for the unravelling of what is a genuine mystery in view of the impression that such companies as the English Electric had enjoyed a good year's trading.

The effect of this announcement caused sympathetic, if unnecessary, dulness in General Electrics, where the ordinary drooped to 30s. 9d. and the preference to 23s. The cable manufacturing shares are steady. Siemens at 32s. 6d. have gained 1/16. India Rubbers are sixpence lower. Both classes of Metropolitan-Vickers have gone ex dividend. As is usual at this time of year, a number of electricity prices are now ex dividend, and the present changes this week in our price-lists represent, in many cases, the deductions of the dividend amounts from the previous quotations.

It may be of service to observe, here, that when a price is officially quoted ex dividend in the Stock Exchange, the practice is to take off, as nearly as possible, the net amount per share paid by the company. In other words, the income-tax is duly taken into consideration. Where prices are regrettably wide, as they are, for example, in certain electricity issues, the deduction is of necessity approximate and not exact. Free acknowledgment may be made of the fact that official quotations are less misleading than they used to be, but there remains wide scope for further improvement in the way of narrowing the margins between the nominal purchase and sale prices, of which the middle figures, taken from the Stock Exchange official sources, are those given in our tables.

When prices are marked ex dividend, and there is no immediate recovery, the yields assume, of course, a more attractive aspect. As an example, Brompton ordinary may be cited, the return, on this week's price, being £6 3s. per cent., or about 5s. higher than that before the holiday. The critic will promptly, and correctly, maintain that this difference should be rectified, from the mathematical point of view, by making allowance for the accrued dividend in last week's price. To carry this into practice, however, and to calculate, every week, the increasing amount of dividend carried in every price, would not only entail doubling or trebling the work, but might lead seriously astray those who are interested in shares upon which the dividends fluctuate.

Apart from some half-score of ex dividend markings, the electricity supply share list is nearly unchanged. The market regarded with composure the second reading of the Electricity (Supply) Bill. It is assumed that the real modifications will come in the next stage upon which the Bill is about to enter.

The dramatic rises in Tube Railway stocks which occurred last week have been well maintained, and the glorious weather that prevailed throughout the holidays formed an added incentive to the previous cheerfulness. London Electric ordinary stock has strengthened to 49, showing a gain of 7 points in three weeks. Underground £10 shares are 5s. higher this week at 3¼

Electric Supply Corporation shares are slightly harder at 33s. upon repetition of the 11 per cent. dividend. Gross earnings for 1925 were £101,024, or £360 below those of the previous twelvemonth. Midland Electric Corporation Power ordinary have risen to 53s. 9d. Bath Electric Tramways 5 per cent. preferred went back to 11s. 3d., in spite of the 1 per cent. increase in the dividend, which gives the shares 3½ per cent. The chairman, at the meeting last week, spoke hopefully of the company's outlook: he mentioned trade conditions and the weather as being two important factors which are beyond the board's control. The Cork Electric Tramways took less and spent less, last year, the upshot being the maintenance of a 6 per cent. dividend on the ordinary shares, and an increase in the carry forward.

Cromptons have gone back to 15s., and the preference to 17s. British Electric Transformer 7 per cent. preference at 19s. 6d. are about 9d. higher on balance.

Anglo-Argentine Tramways continue depressed for the reasons set out in our notes a week ago. Brazilian Tractions, after being 89, rallied to 90¼. British Columbia preferred is better and a slightly better tendency is manifest in Mexican Utility issues.

Cable stocks and shares have few variations in their group. Marconis maintain their advance at 23s. 9d. The company announces inauguration of a wireless service to Moscow. Mr. Marconi has recently undergone an operation from which he is recovering rapidly, Mr. Kellaway stated at the meeting of the Marconi International Marine Company. Shipping showed a little improvement in 1925, said that chairman, but the depression had shifted to the shipbuilding industry. "Since 1921," he observed, "British shipping has passed through one of the worst periods in its history."

Engineering shares are not affected, so far, by the recommendations of the Coal Commission. Babcocks keep close to 53s. 9d. Rubber shares show but trifling signs of activity. The Stock Exchange view is that most markets are likely to move upon humdrum lines until people know what is going to be disclosed by the Budget.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Dividend. 1924	Dividend. 1925.	Price Apr. 6. 1926.	Rise or fall.	Yield. p.c.
Bournemouth and Poole	1	14	—	60/9	—	4 13 4
Brompton Ordinary	1	10	10	1½xd.	—	*6 3 1
Charing Cross Ordinary	1	14½	15	45/9	—	6 11 2
do. do. 4½ Pref.	1	4	4½	17/-	—	5 5 11
Chelsea	1	12	12	2⅛xd.	—	5 16 3
City of London	1	15	15	44/6xd.	—	6 14 10
do. do. 6% Pref.	1	6	6	22/6	—	5 6 8
Clyde Valley	1	8	8	27/6xd.	—	5 16 5
County of London	1	15	15	57/-xd.	—1/8	5 5 2
do. do. 6 % Pref.	1	6	6	22/-	—	5 9 1
Edmundson's Ordinary	1	7	7	23/6	—	5 19 2
do. 7% Pref.	1	6	7	22/-	—	6 7 3
Elec. Supply Corporation	1	10	10	32/6	—	6 3 0
Kensington Ordinary	1	15	15	13¾xd.	—	5 9 1
Lancs. Light and Power	1	7½	7½	26/-	—	5 11 1
London Electric	1	10	10	32/-	—	6 5 0
do. do. 6% Pref.	5	6	6	5⅞	—	5 11 7
Metropolitan	1	11	11	36/3	—	5 15 0
do. 4½% Pref.	1	4½	4½	17/-	—	5 5 11
Midland Counties	1	5½	6	20/-	—	6 0 0
Newcastle-on-Tyne Ordinary	1	7	7	1¾xd.	—	6 4 5
do. 5% Pref.	1	5	5	18/-xd.	—	5 11 1
do. 7% Pref.	1	7	7	24/6xd.	—	5 12 0
Notting Hill 6% Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6% Pref.	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	18⅝	—	5 13 10
South London	1	15	15	2½xd.	—	6 9 0
South Metropolitan Pref.	1	7	7	25/6	—	5 9 10
Urban Ordinary	1	4	4	19/6	—	4 2 1
do. 6% Pref.	1	6	6	1	—	6 0 0
Westminster Ordinary	1	15	15	43/9	—	6 17 9
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	20/-	—	7 10 0
Yorkshire Elec.	1	8	8	25/6	—	6 5 6

Home Rails.

Central London Ord. Assented	Stock	4	4	68	—	5 17 8
Metropolitan	,,	5	5	66½	—	7 10 5
do. District	,,	8½	8½	80	—	7 0 0
Underground Electric Ordinary	10	Nil	Nil	8¾	+¼	Nil
do. do. "A"	1/-	Nil	Nil	10/-	—	Nil
do. do. Income	Bonds	6	6	100	—	*6 0 0

Telegraphs and Telephones.

		Dividend. 1923.	Dividend. 1924.			
Anglo-Am. Tel. Pref.	Stock	6	6	102	—	5 17 8
do. Def.	,,	1½	1½	23⅞	—	6 6 4
Automatic Telephone	1	3	6	2⅞	—⅛	4 2 0
Chili Telephone	5	6	5	6¼	—	*3 12 9
Cuba Sub. Ord.	10	5	5	6⅞	—	7 8 2
Eastern Extension	10	10	10	177½xd.	—	*5 12 8
Eastern Tel. Ord.	Stock	10	10	175½	—	*5 14 0
Globe Tel. and T. Ord.	10	10	10	17⅞	—¼	*5 12 8
do. do. Pref.	10	6	6	10⅞	—	5 11 7
Great Northern Tel.	10	22	22	33	—	6 17 6
Indo-European	25	7	8½	45½	—	*4 13 5
Marconi	1	10	10	1⅛	—	8 8 6
Marconi Marine	1	10	7½	18/9xd.	—	8 0 0
Oriental Telephone Ord.	1	12	12	2⅛	—	*5 16 4
United R. Plate Tel.	5	8	8	7⅞	—	*5 1 7
Western Telegraph	10	10	10	17½	—	*5 15 11

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref.	5	5½	5½	21⅛	—⅛	9 7 2
do. do. 2nd Pref.	5	6	6	2½	—	12 0 0
do. do. 5% Deb.	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord.	,,	6	6	122½	—	4 18 0
do. do. 6% Pref.	,,	6	6	107	—	5 12 2
Brazil Traction	100	4	4	91	—½	5 10 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	84½	—	5 18 4
do. do. Preferred	,,	96/-	96/-	105½	+1	*4 9 4
do. do. Deferred	,,	129/5	129/5	127	—	*5 2 7
do. do. Deb.	,,	4½	4½	75	—	5 13 4
London & Sub. Trac. 5% Pref.	1	2½	Nil	5/6	—	Nil
London United Tram. Deb.	Stock	4	4	48	—	8 6 8
Mexico Trams, 5% Bonds	—	5	5	62½	+1	8 0 0
Mexican Light Common	100	Nil	Nil	32½	—	Nil
do. Pref.	100	Nil	Nil	62½	—	Nil
do. 1st Bonds	—	5	5	68½	—	7 6 0
Yorkshire (West Riding)	1	5	—	14/-	—	7 2 10

Manufacturing Companies.

Babcock & Wilcox	1	12	12	53/9	—	*4 9 4
British Aluminium Ord.	1	5	10	42½xd.	—	4 18 5
British Elec. Transformer Pref.	1	Nil	7	19/6xd.	+9d.	7 3 7
British Insulated Ord.	1	15	15	3¾xd.	—	4 16 0
Brush Ord.	1	10	10	26/3	—	7 12 4
Callenders	1	15	15	3½	—	4 14 10
do. 6½% Pref.	1	6½	6½	22/6	—	5 15 7
Crompton Ord.	1	Nil	Nil	15/-	—1/9	... ...
Edison-Swan	4/-	10	10	8/6	—	4 14 1
do. 5% Deb.	Stock	5	5	83	—	6 0 6
Electric Construction	1	10	10	32/6	—	6 3 1
Enfield Cable, Pref.	1	7½	7½	1¼	—	6 0 0
English Electric	1	5	5	14/6	—4/6	... ...
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/-	—6d.	5 13 1
,, Ord.	1	5	7½	30/9	—6d.	4 17 7
Henley	1	15	15	3⅜	—	4 5 4
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	5	1⅛	—5d.	*4 9 0
Johnson & Phillips	1	10	10	3	—	3 6 8
Met.-Vickers Ord.	1	8	8	24/6xd.	—	6 10 8
do. Pref.	2	8	8	2⅝xd.	—	6 14 9
Siemens Ord.	1	—	7½	1⅜	+⅛	4 12 4
Telegraph Construction	12	20	10	28½xd.	—	*4 4 8

*Dividends paid free of Income Tax.

India's Electrical Imports.

Principal Sources of Supply.

FULL details of India's import trade in 1924-25 in electrical goods, showing the principal countries of supply, have recently been issued. From these the following particulars have been extracted. The corresponding figures for 1923-24 have been added for purposes of comparison and a note of increases or decreases given.

	1923-24. Rs.	1924-25. Rs.	Inc. or dec. Rs.
Control and switchgear.—			
Total	3,618,000	3,647,000	+ 29,000
From United Kingdom ...	3,046,000	3,410,000	+ 364,000
,, United States	236,000	94,000	− 142,000
Generators, alternators and dynamos.—			
Total	3,920,000	3,185,000	− 735,000
From United Kingdom ...	2,953,000	2,948,000	− 5,000
,, United States	845,000	87,000	− 758,000
,, Switzerland	4,000	38,000	+ 34,000
,, Germany	35,000	69,000	+ 34,000
,, Italy	23,000	8,000	− 15,000
Motors.—			
Total	7,226,000	3,972,000	−3,254,000
From United Kingdom ...	4,631,000	3,345,000	−1,286,000
,, United States	1,754,000	343,000	−1,411,000
,, Sweden	449,000	51,000	− 398,000
,, Germany	209,000	127,000	− 82,000
,, Switzerland	17,000	37,000	+ 20,000
,, Italy	41,000	12,000	− 29,000
Transformers.—			
Total	1,539,000	1,322,000	− 217,000
From United Kingdom ...	958,000	1,096,000	+ 138,000
,, United States	542,000	182,000	− 360,000
,, Germany	8,000	11,000	+ 3,000
,, Italy	11,000	6,000	− 5,000
,, Holland	—	25,000	+ 25,000
Turbo-generating sets.—			
Total	1,111,000	407,000	− 704,000
From United Kingdom ...	800,000	252,000	− 548,000
,, Denmark	245,000	—	− 245,000
,, United States	66,000	139,000	+ 73,000
Other electrical machinery.—			
Total	4,844,000	7,693,000	+2,849,000
From United Kingdom ...	3,985,000	6,606,000	+2,621,000
,, United States	655,000	673,000	+ 18,000
,, Switzerland	17,000	3,000	− 14,000
,, Germany	49,000	143,000	+ 94,000
,, France	6,000	21,000	+ 15,000
,, Italy	35,000	28,000	− 7,000
,, Belgium	14,000	14,000	—
,, Czecho-Slovakia ...	—	14,000	+ 14,000
Electric fans and parts.—			
Total	2,915,000	2,553,000	− 362,000
From United Kingdom ...	1,733,000	1,315,000	− 418,000
,, Italy	466,000	482,000	+ 16,000
,, United States	345,000	178,000	− 167,000
,, Germany	325,000	558,000	+ 233,000
Wires and cables, rubber insulated.—			
Total	2,716,000	2,902,000	+ 186,000
From United Kingdom ...	2,450,000	2,681,000	+ 231,000
,, United States	99,000	33,000	− 66,000
,, Germany	32,000	139,000	+ 107,000
Ditto, other insulation.—			
Total	2,228,000	1,966,000	− 262,000
From United Kingdom ...	1,828,000	1,837,000	+ 9,000
,, United States	200,000	10,000	− 190,000
,, Germany	69,000	92,000	+ 23,000
,, Holland	80,000	17,000	− 63,000
,, Switzerland	26,000	—	− 26,000
Telegraph and telephone wires and cables.—			
Total	896,000	212,000	− 684,000
From United Kingdom ...	892,000	180,000	− 712,000
,, Germany	—	18,000	+ 18,000
,, Japan	—	12,000	+ 12,000
Bare copper wire, electrolytic, other than telegraph and telephone wire.—			
Total	1,135,000	1,584,000	+ 449,000
From United Kingdom ...	1,053,000	1,430,000	+ 377,000
,, Germany	14,000	25,000	+ 11,000
,, Holland	7,000	96,000	+ 89,000
,, Japan	52,000	25,000	− 27,000
Telegraph and telephone instruments and apparatus.—			
Total	3,240,000	865,000	−2,375,000
From United Kingdom ...	3,197,000	760,000	−2,437,000
,, United States	20,000	66,000	+ 46,000
Electric glow lamps.—	1923-24. Rs.	1924-25. Rs.	Inc. or dec. Rs.
Total	1,486,000	1,232,000	− 254,000
From United Kingdom ...	577,000	407,000	− 170,000
,, Holland	582,000	531,000	− 51,000
,, Germany	209,000	163,000	− 46,000
,, Austria	39,000	77,000	+ 38,000
,, United States	24,000	18,000	− 6,000
Electric lamps, other sorts.—			
Total	592,000	275,000	− 317,000
From United Kingdom ...	158,000	47,000	− 111,000
,, Germany	141,000	46,000	− 95,000
,, United States	207,000	152,000	− 55,000
Batteries.—			
Total	624,000	729,000	+ 105,000
From United Kingdom ...	370,000	371,000	+ 1,000
,, United States	203,000	203,000	—
,, Germany	45,000	150,000	+ 105,000
Electric carbons.—			
Total	64,000	89,000	+ 25,000
From United Kingdom ...	59,000	75,000	+ 16,000
Accumulators.—			
Total	265,000	1,206,000	+ 941,000
From United Kingdom ...	214,000	987,000	+ 773,000
,, United States	38,000	176,000	+ 138,000
Electric condensers (nearly all from U.K.)—			
Total	2,000	29,000	+ 27,000
Electric bell apparatus.—			
Total	4,500	13,500	+ 9,000
From United Kingdom ...	2,600	2,200	− 400
,, Germany	1,800	6,300	+ 4,500
,, United States	—	4,300	+ 4,300
Lighting accessories and fittings, including switches.—			
Total	902,000	1,392,000	+ 490,000
From United Kingdom ...	695,000	861,000	+ 166,000
,, Germany	144,000	157,000	+ 13,000
,, United States	31,000	332,000	+ 301,000
Meters.—			
Total	524,000	645,000	+ 121,000
From United Kingdom ...	375,000	437,000	+ 62,000
,, Germany	82,000	161,000	+ 79,000
,, Switzerland	37,000	8,000	− 29,000
,, United States	24,000	35,000	+ 11,000
Electro-medical apparatus.—			
Total	105,000	106,000	+ 1,000
From United Kingdom ...	72,000	46,000	− 26,000
,, United States	13,000	27,000	+ 14,000
,, Denmark	—	15,000	+ 15,000
,, Germany	21,000	8,000	− 13,000
Switchboards (other than telegraph and telephone).—			
Total	719,000	408,000	− 311,000
From United Kingdom ...	488,000	389,000	− 99,000
,, United States	205,000	10,000	− 195,000
,, Germany	500	5,000	+ 4,500
Electrical goods and apparatus, unenumerated.—			
Total	4,068,000	3,219,000	− 849,000
From United Kingdom ...	2,934,000	2,154,000	− 780,000
,, Germany	475,000	599,000	+ 124,000
,, United States	397,000	285,000	− 112,000
,, Japan	107,000	101,000	− 6,000

Export Credits Insurance.—The report is to be issued immediately of the Committee appointed last July by Mr. A. M. Samuel, Parliamentary Secretary of the Department of Overseas Trade, to consider the question of insurance against bad debts in export trade. The task of the Committee was to see whether it was possible to devise a scheme for the issue of policies for the insurance of bills which may be drawn for British goods sent into foreign countries, where there may be risk of default owing to war or political trouble, in addition to the ordinary risks of commercial credit. It is understood that the Committee has found it possible to devise a scheme, which, it is believed, answers the necessary requirements. As the Committee comprised representatives of the banks, accepting houses, insurance companies, Lloyd's, the Association of British Chambers of Commerce, and the Federation of British Industries, together with the Comptroller-General of the Department of Overseas Trade, there is every hope that the scheme will find general acceptance.—*The Times.*

High-Power Fusible Cut-Outs.

Some Factors which Influence their Rupturing Capacity, and Research Developments.

By L. C. GRANT, A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers.)

(*Concluded from page 590.*)

Iron-clad Oil-immersed Cut-outs.—Appropriate samples have been tested on short-circuit up to 6,600 volts with satisfactory results, but no tests have been carried out by the author on the higher-voltage patterns. Fuse length and current density are together responsible for the energy loss and consequent heating of the oil. A satisfactory fixed break was evolved for low-pressure work, but for high pressure springs were added to ensure a rapid and long break, and, finally, the contacts were so arranged that in breaking a 50,000-kVA short-circuit

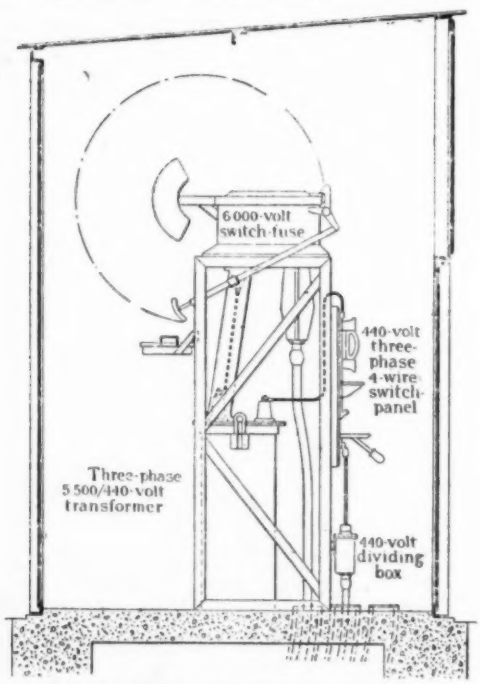


Fig. 5.—Oil-immersed 6,600-V Fuse Installation.

at voltages up to 6,600 V, the distance between the contacts is about four times the maximum arcing distance. In reducing the fuse length, a limit is reached when the end connections exert an appreciable effect on the cooling of the fuse wire. A length of 1½ in. was finally adopted as a workable value; a certain amount of cooling is exercised by the contacts on a fuse wire of this length, but it is consistent, and accurate calibration is possible.

Extinguishing the arc within the first half-cycle, which has been shown by test to reduce the shock to plant, mains, &c.,

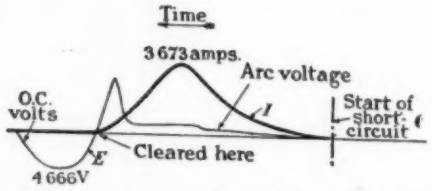


Fig. 6.—Short-circuit Test on Stabilised Arc Fuse at 5,000-V.

to a remarkable extent, necessitated a speed of 30 ft. per second, and the spring was finally arranged for 40 ft. per second. This gives the maximum speed of break without introducing the risk of pressure-rises through enforced decay of the current, an important point. It is of the utmost importance that the speed of break should not be too high, or else the arc will be lengthened too rapidly, a condition analogous to introducing resistance into the circuit.

After oil fuses of this pattern had been in service for some time, the fusible elements gradually became covered with a brown deposit and the metallic portion appeared to be reduced in section cumulatively, until finally the element would melt on reduced current, or even spontaneously. This appeared to be a recrudescence in a new form of the old oxidation trouble experienced with air cut-outs, and in oil was experienced with any ratio of fusing current to load current lower than 3 to 1. In order to avoid this trouble, while retaining a reasonable fusing factor, bi-metallic fusible elements having a copper core sheathed with tin or tin-lead were finally adopted.

In short-circuit tests at 6,000 volts, when breaking 10,000 kVA, the sustained pressures in oil tanks averaged 20 lb. per sq. in. At 20,000 kVA the average of a number of tests was 35 lb. per sq. in., and at 60,000 kVA the pressures reached 150 lb. per sq. in. several times, but averaged more nearly 80 lb. per sq. in.

Oil-immersed fusible cut-outs are suitable for controlling power-station auxiliary motors, for large power industrial work, for networks, &c. They are rated at voltages up to 660 between phases and, with modifications, for 3,000-volt industrial work as an alternative to the high-pressure (proper) oil fuse. It has been found necessary, as with the high-pressure fuses, to use bi-metallic elements. The fuses are not held by any tensioning arrangement, but are retained between fixed contact blocks of considerable mass to reduce heating and the effects of arcing. They withstand the full starting current for 2 seconds without blowing, but should clear a sustained stalling current.

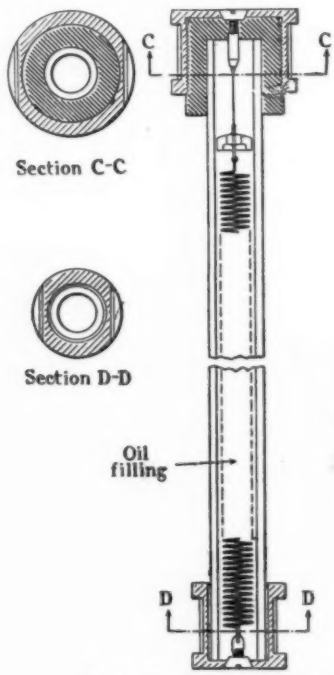


Fig. 7.—Section of Resistance Fuse.

The oil-fuse has been proved capable of breaking load current and isolating a high-pressure circuit by simply swinging back the lid without affecting the fusible elements; it is possible to close it on full load and moderate short-circuits with safety. Fig. 5 shows a typical 6,600-volt oil-immersed fuse installation. A new form of cut-out has its fusible element oil-immersed and the arc characteristic can be consistently reproduced, fig. 6; the arc voltage is quite stable, there being none of the vicious harmonics usually found in an arc characteristic. The process of rupture, as shown in the oscillogram, is clean and rapid and the performance quite different from anything previously experienced. In the test illustrated, the fuse cleared a short-circuit power of 3,673 amperes at 4,666 volts without any visible or audible evidence of its having operated at all. The overall dimensions of the fuse are comparable with many of the old forms of cartridge fuse in common use, which in the test described in this paper proved to be inadequate.

Limiting Resistance.—The majority of the better designs of tubular fuses can be made to function quietly with a series resistance which limits the short-circuit power. Upon reducing the value of the limiting resistance, two things happened: Failure of the fuses commenced and it was found difficult to produce a resistance which could safely be put forward for enclosure in switchgear structures. It was therefore reasoned that the resistance and fuse could well be enclosed in a single container, thus obtaining a dual advantage. A short spring-

controlled fuse was immersed in oil in a tubular container as shown in fig. 7. The resistance wire was made in the form of a spiral to obtain the requisite resistance and to take advantage of the magnetic effect of the turns of the spiral in obtaining a rapid break, and finally resulted in a workable arrangement which could be connected directly across a high-pressure circuit and which interrupted the resultant power without noise, flash, or other unwanted phenomena.

Particulars of a series of tests on ordinary fuses suitable for potential transformers and small power supplies at high pressures are given in the paper. The fuses, rated for 3,000 to 11,000 volts, were of various forms and fillings were employed in a great many. It appears to be the rule that unless such light fuses can be designed to break early in the first half-cycle, they will immediately be destroyed and a dangerous arc across the main contacts be set up. It is not sufficient to ensure that the circuit is cleared in half a cycle, as the current may rise to a maximum in such circumstances. The limiting effect which is so essential is secured only if the fuse is melted on the initial rising current curve.

Conclusions.—It is considered that all cut-outs should be capable of clearing the maximum short-circuit power without any explosive effect, and the investigations have proved that there are now available:—

(*a*) Fuses capable of handling short-circuit powers up to 70,000-100,000 kVA at a maximum voltage of 600.
(*b*) High-voltage tubular fuses capable of interrupting up to 40,000 kVA.
(*c*) A further class of high-voltage fuses capable of interrupting several hundred thousand kVA.
(*d*) Resistance-fuses suitable for any small work, such as the control of small services, potential transformers, and other and more unusual offices, such as the control of wired-wireless equipment.

Truck-Type Switchgear.

A Ferguson, Pailin Composite Installation.

Truck-type switchgear is deservedly popular. Only recently, however, has its suitability for duty involving high rupturing capacity been realised. In the case of an installation manufactured by Messrs. Ferguson, Pailin, Ltd., for a Canadian hydro-electric scheme, the gear is of the composite pattern, the busbars, current transformers, &c., being mounted in a stonework cell structure, the circuit breaker only being of the draw-out truck type.

A general view of one of the switch trucks is shown in fig. 1, the rear view of the same truck being given in fig. 2. The flanged wheels are mounted on roller bearings and grooved rails ensure correct registration; a skeleton framework for receiving the truck portion is accommodated in the circuit-breaker compartment of the cell structure. To facilitate plugging home and withdrawal, truck pinions are fitted which engage with two racks on the stationary framework, and are operated through bevel gearing by a detachable handle at the front of the truck. Interlocks make it impossible to insert this handle until the circuit breaker is off, or to close the circuit breaker until the handle is removed.

Due to the heavy currents involved, it was found impracticable to use the standard cylindrical isolating plug and socket arrangement. Consequently a V-bar and finger type of contact was specially designed so as to have full self-aligning features. The supporting insulators are capable of withstanding large cantilever forces; fig. 3 illustrates the type used, and it will be noticed that the plug insulators are provided with long back connections suitable for passing through the cell walls into the other compartments of the structure. The shortness and rigidity of the connections between the circuit breaker terminals and the isolating sockets should also be noted.

Each truck unit is equipped with a type PA triple-pole oil circuit-breaker rated at 1,200 amps. at 15,000 volts, a common top plate being provided for all three phases, heavily ribbed and giving a large air space above the oil level. A baffled vent is fitted on each phase and is provided with a gas separator which returns ejected oil to the tank when the pressure has subsided. The tanks are elliptical in shape, supported from the top-plate by a steel cradle and down-rods, a rope gasket preventing oil throwing. The rope and pulley tank-lowering mechanism is operated by the same detachable handle as is used for racking the unit in and out, and it is impossible to insert the handle until the truck is withdrawn.

The glazed porcelain insulators are cemented into clamping rings which are bolted to the top plate, thus facilitating renewals. The switch contacts are of the standard Ferguson-Pailin finger and inverted V-bar type, the apex of the V being truncated to allow the opening motion to squirt fresh oil on to the contacts; arcing contacts of large capacity are fitted.

Electrical operation by means of d.c. solenoids is used throughout. The mechanism is energised by a single-pole contactor, both contactor and solenoid being mounted on the front sheet of the truck. The operating and tripping supply is brought in by means of auxiliary finger contacts on the truck which make contact with auxiliary bars on the side of the stationary framework; they are clearly seen in the illustrations. The auxiliary bars are of such a length that the truck can be withdrawn a safe distance for isolation without interrupting the auxiliary supplies, thus enabling the circuit breaker to be tested, but interlocks prevent the operation of the breaker if insufficiently isolated.

Fig. 1.

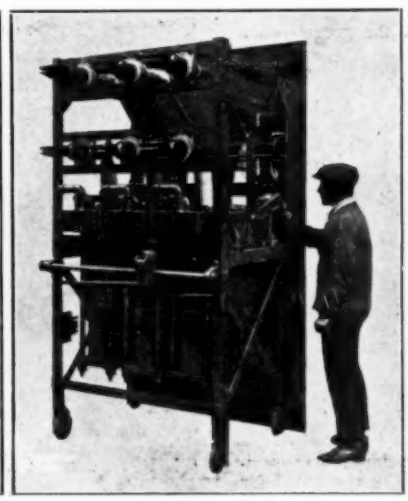


Fig. 2.

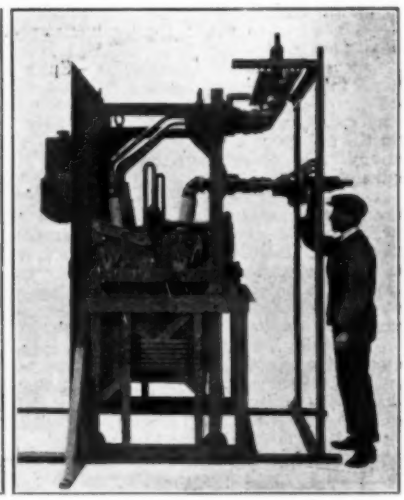


Fig. 3.

A Ferguson, Pailin 1,200-Amp., 15,000-Volt Draw-out Switch Truck.

Canadian Water Power Dispute.—The *Daily Telegraph* states, with regard to the debate in the Dominion Parliament in favour of drastic action through the British Government to enforce Treaty engagements entered into by the United States concerning water rights in the Great Lakes, that the whole question has become more acute of late years, owing to the reduced level of the water in the canals and the resulting bad effects on important water-power developments, not only in Canada, but also the United States. There has been continual agitation on the part of Canada, and also of the Eastern American States, to have these defects rectified. The difficulties are rendered more acute by the increasing water demands of Chicago simultaneously with similar demands of Canada and the United States for water for navigation and power purposes. The Canadian point of view for the moment is that the legal rights of the Dominion shall be backed up by the British Government and the British Ambassador at Washington, in order that Chicago may be forbidden to break the existing Treaty, which, in effect, limits the amount of water to be used either by Canada or the United States. Canada now realises that the time has arrived for the United States to take the necessary measures to prevent the increasing diversion of water. Any representations on the subject would be made through the Governor-General of Canada, the Dominions Officer in London, and the British Ambassador in Washington.

The Propagation of Radio Waves.

Some Results of the Radio Research Board's Investigations.

By J. HOLLINGWORTH, M.A., B.Sc., A.M.I.E.E.

(*Abstract of paper read before the* WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper outlines the results obtained from a systematic study, by the National Physical Laboratory on behalf of the Radio Research Board under the Department of Scientific and Industrial Research, of the received intensities of various long-wave transmitting stations at four receiving stations over a period of nearly two years. The weekly averages of the results are studied, and it is shown that they are inconsistent with any law of stead decay. The results also show very marked periodic variations.

Seasonal Intensity.—The most striking feature of the observations (over the period June, 1924, to December, 1925) is the fact that in the early months one station recorded signals equal to, and even greater than, those at another, although the distance were 695 km. and 485 km. Also on the few individual days when variations did occur, they usually appeared at all stations, but not necessarily in the same direction. An unusually high value at one station was generally accompanied by a low value elsewhere.

During September, 1924, although the change in weekly averages was mostly small, day-to-day variations became much larger; and at the same time it was noticed that the bearings were becoming unsteady and the minima poor. In October, however, big changes began to occur, culminating in sudden and enormous variations in the week October 25th to November 1st. The first, and most striking, characteristic was the simultaneity of the changes. In these few days signals from stations far apart at receivers far apart, showed abrupt changes, amounting in some cases to over 100 per cent. The effects were not merely transient, as in most cases, although the day-to-day unsteadiness was very marked, there was in the following weeks no definite reversion to the summer values.

It is hardly possible to avoid the conclusion that these changes were not due to local variations, but to some main cause operative over a large area, and the possibility is also suggested that all signal-strength variations might be due to this cause, differing in degree rather than in kind. Also, in view of the fact that signals were practically equal when their path was entirely over land and entirely over sea, it does not seem possible to admit the conductivity of the ground as a major controlling factor.

Intensity/Distance Distribution.—Space-distribution curves (*i.e.*, intensity plotted against distance and not against time) obtained by means of a portable measuring set on four tours, one extending to Aberdeen, are entirely free from anything in the nature of a steady decay, and seem to justify very definitely the claim for the existence of an interference phenomenon.

General Inferences.—An interference phenomenon demands two waves. The velocity of propagation of a "surface" wave over a semi-conductive layer is slightly different from that of a "free" wave in space. At first sight, this suggests a possible explanation of the phase-changes necessary to produce an interference effect, but calculation shows that by the time a sufficient phase-change had occurred due to this cause, the "surface" wave would have been attenuated to a negligible intensity. Therefore, the explanation must be found rather in difference of path length than in velocity of propagation, and this leads at once to the idea of the upper layer, which forms the basis of most of the methematical work on the subject, but it has been claimed that all observed phenomena can be accounted for without its assistance. Assuming the existence of such a layer, but with its characteristics unspecified, all the results obtained in the paper can be accounted for if certain definite constants are attributed to it. At this stage of the work it is impossible to give a decision as to the actual physical nature of the layer, its constitution, or its sharpness of definition. Consequently, it cannot be said definitely whether the effect is strictly one of refraction or reflection, or, as seems likely, of an intermediate nature. In all that follows the word "refraction" is used in this indeterminate sense and must not be more strictly interpreted.

The distances at which maxima and minima should occur for various heights of layer have been calculated and plotted. With regard to these curves, it is very important to note that the actual positions of the maxima and minima are independent of the attenuation of either of the waves, a fact which is of great value, as it eliminates some of the most uncertain of the unknown factors. The actual intensities at these points are, however, entirely dependent on the attenuations, so that the interference phenomena will exhibit all degrees of intensity. At short distances, where the surface wave is strong and the refracted wave weak, due to the small angle of incidence, the maxima and minima will follow in rapid succession as the distance varies; but their actual excursions will probably be so small as not to be definitely separable from the irregular momentary and daily variations. As the distance from the transmitter increases, the effects will become more and more marked, and an almost total extinction may be obtained; whilst at greater distances, due to the large attenuation of the surface wave, the effect will again diminish, if by this time it has not totally disappeared, as the last minimum will be at the point at which the two paths differ by half a wave-length.

It thus appears that, at any rate up to this date, all the major elaborate variations observed are explicable on the assumption of a refracting layer at a height of about 75 km. during the summer months, rising somewhat abruptly during October to a height of about 90 km.

This does not, of course, definitely prove the existence of such a layer, and all that can be said at present is that it offers what appears to be the simplest explanation, which, at the same time, covers all the most marked observed phenomena.

Seasonal Variations.—The abrupt transition at the end of October appears to mark a distinct line between summer and winter, and it seems impossible that the winter change is merely a reversion to normal night conditions. The two may be related, and probably are, but they do not seem to be identical.

For the daylight stations the results appear to group themselves into two sections, that from May to September being marked by its relative stability, and that from October to May both by average values differing largely from the summer ones, and also by a very pronounced day-to-day instability. Also, it has been shown that the marked change at the end of October is consistent with a rise in height of the layer from 75 to 90 km., so that it seems natural to suggest that some, at any rate, of the winter variations are due to the same cause.

One point in connection with the layer appears to be very striking. A change in height of only about 10 km. may be sufficient to convert the signal at a given point from a maximum to a minimum; now the readings during the summer show that the day-to-day variations at any given point are often only a few per cent., and that even the weekly average for the same week in successive years may not differ by more than this amount. Consequently, although it appears that the layer undergoes a nightly change, it must go through a cyclic change of extraordinary constancy over periods measured by weeks, if not by months.

Sunset Effects.—Summer intensity went through a very marked cycle of change, which was repeated daily with only very minor modifications. Whilst the same thing was true at every station, the actual curves obtained had entirely distinctive and different shapes. The effect can no longer be classed under the general heading of "night increase," but must be, although perfectly systematic, of a much more complex nature. Now it is generally held by the supporters of an upper-layer theory that, with the removal of sunlight, the effective height of the layer increases. Following out this idea, the variations at all stations are explicable on the basis of a rise in effective height from 75 km. to 90 km., bearing in mind the fact that a minimum is not necessarily a zero.

Another interesting, though tentative, calculation can be made from these results; it is possible to determine the actual values of the maximum or minimum attained at each station, and sometimes both, depending on the range of the curves. The intensity of the diffracted wave can also be calculated from the formula given by Watson and by Van der Pol, and hence the intensity of the reflected wave is known. From this the equivalent reflecting power of the layer can be deduced, on the assumption that the intervening air is a perfect dielectric.

These results are interesting, especially as showing the rapid falling off of reflecting power for larger angles of incidence, which is not altogether unexpected, but like many other figures in the paper they must be subject to further verification.

Conclusions.—Whilst many of the ideas suggested cannot at present be regarded as much more than guesses at a possible state of affairs, it may be as well to state some of the definite facts that rest on experimental evidence.

(1) Long-wave signal intensities over medium distances ($< 1{,}200$ km) remain extremely steady over the period May to September, during daylight hours.

(2) Their distribution does not correspond to the Austin-Cohen formula for anything less than yearly averages, in which case the distance is not large, and the law of decay is not uniform.

(3) During the sunset period each station goes through a distinct and individual cycle of change, which is repeated daily.

(4) Towards the end of October all observed stations showed simultaneous and large departures from their summer values; this is the beginning of a period of marked day-to-day instability, which persists until the following May, by which time all stations have settled down to their normal summer values.

(5) Careful plotting of a day-time intensity distance graph gave an undulating curve, showing, under certain conditions, practical extinction at a definite distance.

(6) In addition to the slow periodic changes, there appear to be more rapid fluctuations superimposed; during the summer months they are comparatively small, but assume big intensities during the winter; there is not yet evidence to decide whether these are due to fluctuations of layer height too small and rapid to be definitely detected by present methods, or whether they are due to some totally separate cause.

The actual results in this paper are definitely confined to medium distances and long waves:

(a) *Long distances.*—The interference phenomena discussed above have a definite upper limit of distance for two reasons: The first is that, on the assumption that they are caused between a refracted and a diffracted wave, the attenuation of the latter is so large that at great distances its effect is negligible. Secondly, the effects cease when the difference in path length for the two waves becomes less than half a wave-length; and this, together with the curvature of the earth, places a definite geometrical limit on the possible distance, there being also a maximum range for a first reflection with a given height of layer. The idea of multiple reflection cannot, however, be excluded, and it is conceivable that the signal from a distant station would consist of the vector sum of a series of multiple reflections.

(b) *Short waves.*—There is danger in applying these results directly to wave-lengths below 1,000 metres, for, whilst the presence of such a suggested upper laver would be a very important factor in short-wave propagation, the difference in frequency is so great that there is no doubt but that the actual observed phenomena would be entirely different.

Northern Telephone Development.

Progress Achieved on the North-East Coast during 1925.

THE continued depression in the staple industries of the North-East Coast has not been without its effect on the telephone service, but this is reflected more in the number of calls made than in the number of orders obtained for new telephones, and substantial progress was made in 1925 in the number of telephones in use. These facts are made apparent by the annual reports of the Chamber of Commerce Telegraph and Telephone Advisory Committees for the Newcastle-on-Tyne and Middlesbrough areas, of which copies (abstracted below) have been sent us by Mr. J. R. M. Elliott, M.I.E.E., superintending engineer, Northern District, Post Office Engineering Department.

Newcastle-on-Tyne Area.

In the Newcastle district at the end of December, 1925, there were 29,813 telephone stations, a net increase of 75 per cent. since January 1st, 1912, the rate of increase comparing favourably with the pre-war increase. The retrograde effect of the war has been overtaken, and since the war development has been well maintained.

The total number of stations (29,813) includes 28,517 subscribers' exchange telephones, the remainder representing call office, service, and private wire stations. The total number of private householders renting circuits at the reduced residence rates was 3,441, a percentage of over 12. Exchanges numbered 113; call office station 446; street telephone kiosks 37; new exchanges opened under the rural development scheme of 1922, 18; and rural party line stations 94; while one rural railway station was connected with an exchange system. During the period January to December, 1925, the increase in the system, inclusive of 1,789 transferred from the Middlesbrough district in August, amounted to 3,280, the net figure being 1,491 stations. Agreements for the erection of street kiosks have been completed with seven municipal corporations and with three urban district councils, and 21 public call offices were opened at small post offices where telephone facilities did not exist previously.

The exchange at Whitley Bay was removed to a new building and a modern common-battery exchange to afford accommodation for 800 subscribers' lines installed; this work involved the replacement of all the old subscribers' telephones. Three other exchanges were removed to more commodious premises and (as well as at four other centres) new equipment of the common-battery signalling type installed. Switchboard extensions have also been made at 18 places, while extensions are now in progress at 10 exchanges and three new rural exchanges were established.

Trunk and junction lines joined up numbered 88 and over 27,500,000 effective originating local and junction fee calls were made, whilst the number of trunk calls was in excess of 2,300,000. Telegrams received by telephone from the public exceeded 310,000. The minimum deposit required from subscribers in respect of trunk and local call fees was reduced by 10s. as from July 1st, 1925, affecting 8,600 subscribers whose average quarterly use did not exceed 30s.

Particular attention is paid to the telephone possibilities of undeveloped areas and those in which building reconstruction is likely to take place; the whole of the larger exchange areas in this district have been covered and the studies made during 1925 included 17 areas, following which comprehensive systems of underground plant in 20 places have been carried through to completion during the present year, while 16 local underground schemes are in active progress and further works of this nature will shortly be commenced. In large buildings containing several suites of offices it is now the practice to make a development study and then cables containing a sufficient number of wires to meet all probable requirements are led into the building and distributed from the basement within the building. Six buildings in Newcastle-upon-Tyne have received attention in this way.

Intertown and long-distance service cables which have been completed in the Northern Engineering District during the current year and are now being gradually brought into use number 12, in addition to others at present being provided. The Newcastle-Catterick cable will provide underground telephone communication throughout between Newcastle, Leeds, Hull, Manchester, Liverpool, Sheffield, London, and other towns; the Newcastle-Catcleugh cable will provide underground communication from Newcastle to Edinburgh and Glasgow, and both cables will be used for communication between Scotland and the South, East, and West of England.

It is not usually appreciated that an open wire telephone circuit possesses inherently a much higher transmission value than a circuit of similar gauge contained within a cable, but conversation over long distances by means of cable circuits has become possible with the aid of Pupin loading coils and the thermionic telephone repeaters. The former are fitted at distances of approximately 2,000 yards apart and repeater stations at 50 mile intervals; two of the latter have lately been completed in the Northern Engineering District at Catterick (Yorks.) and Kenton (near Newcastle), and it is expected that both will be brought into use during the early part of 1926. As a temporary measure, however, a provisional repeater station has been installed in Newcastle, through which certain long-distance underground circuits are at present working.

The conversion from manual to automatic working of the telephone system within a radius of five miles of Newcastle has been decided upon, and building operations have been commenced. The three automatic private branch exchanges that have been installed are giving every satisfaction.

The total mileage of underground main lines (trunk and telegraph) increased from 12,545 to 40,819 in 1925, while the total underground local (subscribers') line mileage increased from 46,925 to 55,816, the grand total being 96,635 miles.

Middlesbrough District.

In this area development proved to be fairly satisfactory under the very adverse trade conditions prevailing; the depression in the iron, steel, and shipbuilding trades particularly was to a great extent responsible for the cessation of many telephones, the number on December 31st, 1925, being 10,514, as against 11,603 at the end of December, 1924, but on August 1st last, 1,789 telephones were transferred to the control of the Newcastle Telephone District, and the net increase during the year for the Middlesbrough District was therefore 700 telephones.

Two new rural exchanges were opened and one was removed to more commodious premises and exchange equipment of increased capacity installed. Extensions of exchange equipment have been carried out in nine cases and two others are in progress.

At Hartlepool and West Hartlepool new automatic exchanges are in course of construction, and the opportunity is also being taken to considerably augment the underground plant; it is anticipated that the change over will take place in July. Automatic working has been decided upon for Middlesbrough, South Bank, Linthorpe, and Stockton-on-Tees, and building operations of an extensive character are already in progress. The installation of modern common-battery equipment at two exchanges has been decided upon.

There has been a large increase in the number of call offices during the past two years, which development has been accelerated by the provision of kiosks in public places; twenty are now working in the district, one is in course of erection, and negotiations are in progress for four more. The total number of call offices at end of 1925 was 229.

In the Middlesbrough District, following development studies, comprehensive underground systems have been carried to completion in six places and at present local underground schemes are in active progress at 11 places. The effective trunk calls actually brought to account during the quarter ended December 31st last reached 278,620. Telegrams received by telephone from the public exceeded 40,400, whilst the local effective calls handled and charged for were slightly in excess of 159,000.

The total mileage of main underground lines (trunk and telegraph) increased during the year from 5,925 to 18,458, and that of the local (subscribers') lines from 12,984 to 14,605, the grand total being 33,063 miles.

New Electrical Devices, Fittings and Plant.

(Readers are invited to submit particulars of new or improved devices and apparatus.)

A Direct-Reading Portable Wheatstone Bridge.

A recent production of the India Rubber, Gutta Percha and Telegraph Works Co., Ltd., Silvertown, London, E.16, takes the form of an instrument of the above description, fig. 1, which has been designed to fulfil the demand for a cheap and reliable design of portable Wheatstone bridge for the rapid measurement of conductor resistances. The apparatus is self-contained, and rotary switches for varying the adjustable-arm resistance are mounted on the under side of the panel. The resistance values are indicated through circular openings in the switch covers and the ratio arm can be set to read directly or in multiples of 10. The instrument is fitted with a moving-coil galvanometer of suitable sensitivity, and battery and galvanometer keys are provided, the battery of dry cells being fitted into a compartment in the bottom of the teak case. The apparatus is claimed to be suitable for hard usage and always ready for immediate use.

The switches are provided with rubbing contacts of ample proportions, thereby ensuring clean contacts of negligible resistance. There are only two connections to make when using the instrument, the resistance terminals, and technical knowledge of the Wheatstone Bridge is not necessary on the part of the operator.

Fig. 1.—Portable Wheatstone Bridge.

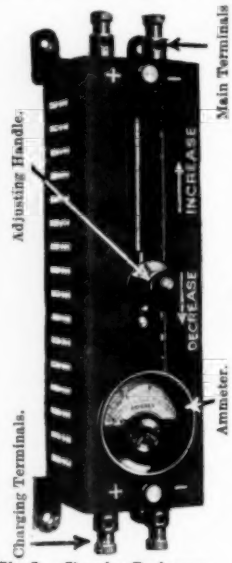


Fig. 2.—Charging Resistance.

A New Charging Resistance.

In order to meet the demand for a simple and cheap apparatus which will enable h.p. wireless accumulators of small capacity to be charged from the supply mains, the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2, has introduced a d.c. charging resistance, fig. 2. The unit consists of a slate former, wound with resistance wire of ample rating and low-temperature rise, the complete winding being treated with heat-resisting cement. The current regulator consists of a self-aligning brush, which slides over the turns of wire, and the regulation obtained is claimed to be suitable for controlling the charging of a 60, 100, or 150-volt accumulator at 150 milliamperes, from a 110 or 220-volt d.c. supply. The complete apparatus is self-contained with a dead-beat ammeter and incoming and outgoing terminals, mounted between two cast-iron end pieces with a sheet-metal cover, finished black.

An Improved Electric Iron.

The Coventry Electrical Accessories, Ltd., Conduit Yard, Fleet Street, Coventry, has recently marketed an electric iron, Patent Point, fig. 4, in which is incorporated a special device for heating the nose of the iron. A piece of material of high heat conductivity is introduced into the base of the iron at the nose, and it is claimed that this attracts the heat to that part of the apparatus, resulting in a constant temperature there. It is claimed that the introduction in this iron of the heat-conductivity piece renders it only necessary to have the iron on circuit for about three minutes for a half to three-quarters of an hour's working, resulting in an energy saving of 80 or 90 per cent.

A Solid-Contact Lampholder.

The J.K.W. Manufacturing Co., Ltd., 1 and 2, Bridge Street, Middlesbrough, has recently produced a solid-contact lampholder which embodies closely the design features of the ordinary lampholder without, it is claimed, the disadvantages of the previous designs of this type. The contacts are each of one solid piece and they are embedded in a porcelain base of the usual "S" design. The outstanding feature is the single spring which controls the two plungers together through the porcelain block. This rests on internal projections in the top part of the case, so that it always remains in place when the porcelain is removed. The design of the device is such as to necessitate no departure from the usual method of wiring the holder, and it has exactly the same external appearance as the ordinary holder. Fig. 3 shows the device externally and in section. Electrical continuity is ensured by the solid contacts, and the latter are self-aligning. Arrangements are being made for the manufacture of types of bayonet holders other than that illustrated.

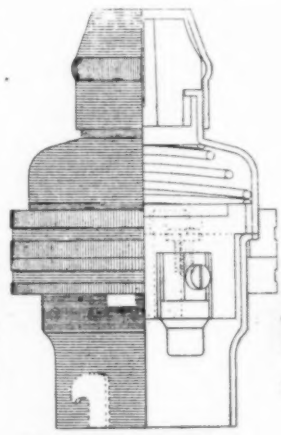


Fig. 3.—Solid Contact Holder, Part Section.

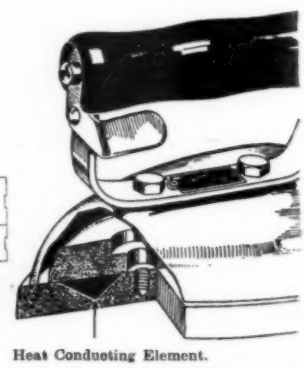


Fig. 4.—Improved Electric Iron.

A Switch Development.

Messrs. S. G. Leach & Co., Ltd., 26-30, Artillery Lane, London, E.1, have sent us a sample of their new flush-pattern "Adnil" press-button switch, which they have recently introduced, complete with the necessary conduit box. The switch is constructed on an ebonite block which forms the face of the device, the mechanism being entirely enclosed in the conduit box to which the switch is screwed. The action is positive and the break is quick and controlled by a V-shaped flat phosphor-bronze spring. The two press-buttons, "on" and "off," are also of ebonite, rendering the appliance shock-proof, and they are permanently attached to the switch contact arms. The external appearance is pleasing, and it is recommended for use in hospitals on the grounds that the plain polished surface will not harbour dust and that there is no risk of shocks.

Fig. 5.—Conduit Boxes.

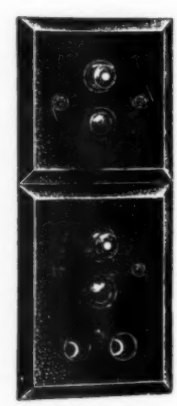


Fig. 6.—Press-Button Switches.

The conduit box appears to be constructed of stamped sheet-iron and is fitted with external lugs and screws which enable two or more boxes to be coupled together where more than one switch is required. The box is provided with three entry holes for ¾-in. conduit, and reducing nipples are supplied in cases where it is required to use smaller conduits. Figs. 5 and 6 show two of the switches and two of the iron boxes mounted together.

Commercial Electric Cooking.

Final E.D.A. Conference of the Session.

MR. D. N. DUNLOP (B.E.A.M.A.) presided at the final Salesmanship Conference of the E.D.A. this session in London on March 26th. The subject for discussion was "Progress and Prospects of Commercial Electric Cookery," and Mr. J. J. MCKENNA, in presenting a paper on the matter, said that the rapid progress of the domestic electric cooker had been due mainly to the hiring out system, the low cost of electricity, the improvements in design to meet the requirements of the modern home, and the increasing reliability of the elements. The progress of commercial cooking, though not so rapid, was nevertheless satisfactory. There were numerous equipments all over the country giving excellent service and paying their way, proving effectively that electric cooking was not expensive and unreliable. Some of those commercial equipments had been in daily use for ten years and were still as serviceable as ever. There was still an enormous and practically untouched field for development, with a vast potential source of revenue for the supply authorities and a remunerative outlet for the energies of the salesman. It should be remembered, however, that the conditions governing the installation and use of kitchen equipment were not so favourable as those appertaining to the domestic electric cooker. Apart from the fact that the latter had the advantage of established hiring schemes to further its progress, the commercial equipment, on the other hand, was more often purchased outright and had the extra disadvantage that its operation was in the hands of a paid staff who probably would not handle it so carefully as the housewife. Future development should take account of the cost of energy, the suitability of the apparatus, and the question of reliability and quick operation. A good deal of spade work had been done in introducing electric cooking on a large scale into many canteens and restaurant kitchens, but sales in themselves should not be regarded as the main thing, because a good deal more harm than good could be done by pushing electric cooking of any description in circumstances where the conditions were adverse to the economic and smooth working of the equipment. For instance, it was directly harmful to push electric cooking where the charge for energy was 1½d. per kWh or over, unless the cost of gas was correspondingly high. There were cases, of course, where the quality of the cooking was of greater importance, but these were rare and too often the reputation of electric cooking suffered because the cost of energy was too high. It was fairly well established, from the records of electric kitchens that had been in daily use for a period of years, that the consumption of energy might vary from 0.2 kWh per meal cooked in a canteen using a combination of electricity and steam to 1.5 kWh in a canteen with an all-electric kitchen. The cost of energy should not exceed 1d. per kWh where competition was keen and should in most cases be in the region of ½d. per kWh. Equally important was the necessity for supplying the right type of equipment for the requirements of the particular case. The general lines on which the needs of the purchaser should be studied were set out as follows:—The number and type of meals that were being served; the period during which the service of meals took place; the availability or otherwise of hot water for washing up and for cooking, also whether it was proposed to use a combination of steam and electricity for cooking, or electricity only; and the space available in the kitchen and servery. Care should be taken not to over-estimate the capacity of the equipment. Maintenance costs were at present high and they could be traced almost entirely to the failure of heating elements used in the boiling of liquids, and it was those same elements which were responsible for the majority of complaints regarding the slowness of operation of electric cooking apparatus. The manufacturer was therefore faced with the problem of producing a really quickly operating and efficient boiling plate, of limited dimensions containing a practically indestructible element. The solution would appear to lie in the use of a high resistance material other than nickel-chromium wire, if this were obtainable, or else in an absolutely enclosed and air tight element free from possibility of oxidation, *i.e.*, an element embedded in a substance of good insulating properties, of a high thermal conductivity and free from any tendency to powder through the "breathing" of the element wire. Such a material could confidently be expected in the near future. Once this difficulty had been overcome, there was nothing to stop the universal adoption of electric cooking for all purposes except the cost of energy. It was necessary to provide better facilities in large towns for the training of chefs and cooks in the use of electric cooking apparatus.

Discussion.

The ensuing discussion turned mainly upon questions affecting domestic electric cooking, and had little bearing upon the paper.

The CHAIRMAN himself dealt with the domestic cooking aspect by giving an indication of the progress that is being made by way of sales of apparatus. In the June quarter of 1924 he said there were more than twice as many domestic cookers installed as in the corresponding period of 1923, that number being six times as many as in 1922, and 30 times as many as in the June quarter of 1921. The figures for 1925 had not yet been completed but there were indications that they showed a considerable increase.

Mr. RAYNER (Manchester) spoke of the rapid development of the domestic electric cooking load there and also mentioned that electric cooking was being taught at the Manchester College of Domestic Economy.

There were differences of opinion as to whether simple hire or hire-purchase was the better arrangement and Mr. LEEVERS (Hotpoint Electric Appliance Co.), who advocated the former, spent some time giving the outstanding features of the electro-inducer system which was described in our last issue.

Several speakers also severely criticised the shortcomings of the usual boiling plate, although one speaker said that its success depended upon sensible use by the operator.

Mr. C. H. HAYES put in a plea for a greater degree of standardisation of electric cooking apparatus as an important means for reducing maintenance costs.

Mr. EDINBURGH commented on the difficulties encountered in inducing the chefs in large establishments to change over to a new method.

Several speakers urged the necessity for lady demonstrators of electric cooking apparatus rather than men.

Mr. E. P. LOVELL (Stoke Newington) said that he had found an American cooker to suit his purpose best. What, he asked, was to be the attitude to adopt in such a case? Should he adopt British apparatus because it was British, or should he recommend the American? He was inclined to the latter view.

Mr. MCKENNA briefly replied and expressed his disappointment that so little had been said regarding commercial electric cooking. He particularly stressed the need for training kitchen staffs.

In all, there were 22 speakers in the discussion but there were practically no contributions towards the subject of the paper.

Mr. BEAUCHAMP, in closing the series of conferences for the session, said that he was convinced that commercial electric cooking was going to be a big thing and he urged manufacturers to keep the Press informed, through him, of the progress and new developments that were being made.

Russian Electrical Notes.

The Schatur Generating Station. — The activity of the Schatur station in 1924-25 has just been reported on to the Supreme Council of National Economy. It is stated that the station carried out its supply programme to the extent of 81.5 per cent. and earned net profits amounting to 7,600 roubles.

Works for the extension of the station are reported to be in full progress, and the erection of three new boilers and the foundation for a third turbo-generator are proceeding, this machine being intended to be started next autumn. It has been decided to install two further 35,000-kW turbo-generators and the necessary steam-raising plant. The capacity of the station will then be 118,000 kW, as compared with the 83,000 kW originally contemplated.

The Accumulator Trust.—The report of the Accumulator Trust for 1924-25 shows that the production represented a value of 2,035,000 roubles, of which a total of 82.6 per cent. was sold. It is now proposed to increase the output of products which are in most demand. The Trust is said to have incurred a loss of 90,000 roubles in the past year.

The Electrical Bank.—At a recent meeting of the shareholders in the Electrical Bank, it was stated that during the eleven months ended with last November it had been possible for the bank to carry on without any subsidy from the State and that it had been able firmly to stand on its legs and take up a stable position among the large banks in Soviet Russia. The bank had recently been able to enter into an agreement with the National Commissariat of Finance under which the funds allotted for works of electrification in 1925-26 will be paid into the electrical bank. The net profits are stated to have amounted to 1,179,000 roubles in 1924-25; the share capital is to be increased to 15,000,000 roubles, and the term for short loans has been raised to one year and that for long loans to ten years.

Lamp Production.—The electrical section of the conference on the restoration of industrial capital has decided that it is necessary to organise the manufacture of lamps at the former Provodnik works, which has been leased to the General Electric Trust. The adaptation for this purpose will involve an expenditure of 2,700,000 roubles, of which 1,800,000 roubles is required for the acquisition of equipment. In connection with this scheme it is considered that the output of lamps should be increased to 67,000 per day and the costs of production largely reduced. It is also proposed to hand over to the Accumulator Trust the production of primary batteries.

The Shteroff Station.—As a result of delays in the receipt of certain equipment from abroad it is not expected that the Shteroff station will be opened for service until next May. The station will be the first of its kind in Russia to utilise pulverised coal as fuel. It will be equipped with 80,000 kW of plant, of which two Vickers turbo-generators, each of 10,000 kW, have been erected.

New Stations.—Schemes for the construction of various new generating stations have been placed before the Electric Planning Commission for consideration. Besides these particular projects the commission will deal with the proposal to erect a new large station to use South Moscow coal for supplying Moscow, and a committee will shortly meet to decide on the actual site to be adopted for the purpose of the station, which is to have a capacity of from 80,000 to 100,000 kW.

Growth of Electricity Supply.—According to information issued by the General Electric Commission, considerable expansion in the supply of electricity took place in the fiscal year ended with last September, particularly in the large industrial centres. The total production of the stations which are under the supervision of the Commission, forming 95 per cent. of the capacity of the public stations, is stated to have amounted to 1,131,000,000 kWh in 1924-25, as compared with 904,000,000 kWh in the previous year. The Moscow stations occupied the first place in 1924-25 with 365 million kWh, the Baku stations were second with 283.4 millions, and the Leningrad stations third with 211.6 millions. Including the other stations of public utility, the total output in the past fiscal year is stated to have been 1,200,000,000 kWh, while if the output of the private generating stations at industrial works is added the aggregate for the Republic comes to about 3,000,000,000 kWh.

Railway Electrification.—A commencement is to be made upon the electrification of the Russian suburban railways, the National Commissariat for Railways having recently placed orders with Soviet works for the construction and delivery of five motor cars and ten trailers for the Moscow suburban railways. Each train will be composed of one motor-car and two trailers as a rule. The trains will run on the Moscow-Losinoostrovska line and all the works are to be completed this year, while traffic will be commenced in the spring of 1927. An extension of the working is proposed as far as the stations of Pushkino and Schelkovo, together with other stations. The estimated total expenditure on the work is put at 30,000,000 roubles (£3,000,000).

The Productive Programme.—The State Planning Commission has approved a report relating to the electrical manufacturing programme for 1925-26. In 1924-25, based upon the list prices which prevailed in 1913, the value of the production of electrical manufactures amounted to 64.4 millions of roubles or 68 per cent. more than in the previous year. The gross value of the output in 1925-26 is estimated at 104.9 millions, of which 87.8 millions will comprise heavy products and the balance low-pressure manufactures. In addition the two trusts which are not subject to the Commission will turn out cables and other manufactures to the value of 25 millions of roubles. The execution of this programme will necessitate an increase in the number of workers from 20,500 to 27,000. The capital expenditure on the extension of the productive capacity of the works is estimated at 13,000,000 roubles, while a further sum of 12,500,000 roubles is needed to place the credit conditions of the industry in order, and most of this sum is to be advanced from the loan for the restoration of industry.

The White Sea Cable.—A special expedition is to be organised this year for the restoration of the cable between Archangel and Murmansk, which is now out of service, the length being about 500 miles.

Heating Apparatus Manufacture.—The General Electric Commission has decided that the bulk production of electric heating apparatus both for domestic and industrial purposes shall be embarked upon at the works of the State Electrical Trust.

Peat Fuel Station. — Having considered alternative schemes the Electric Planning Commission has decided that it is necessary to provide an additional capacity of 40,000 kW at the Krasny Oktyaber station for assisting in meeting the requirements of Leningrad. The Commission has referred the technical side of the problem to a committee to decide whether one or two sets should be installed.

Delays in Deliveries.—Complaints have been made by the Rural Electrification Department of difficulties in obtaining the delivery of electrical equipment. Applications and orders on the part of the peasant companies are increasing, but the department is unable to accept them owing to these difficulties. In the case of portable steam engines the Maltsov works states that it is unable to execute such orders in less than 10 months and even then only on receiving the necessary materials. Moreover, the works of the General Electrical Trust require from 14 to 18 months to carry out orders for generators and motors.

Development in Transcaucasia.—It is announced from Tiflis that the State Planning Commission has approved a five years' scheme of works, including the completion of the construction of the Erivan and several other stations during the current year. An investigation is also to be made of water power resources with a view to the establishment of various hydro-electric works in this region.

A Coal-Dust Station.—The Planning Commission has approved a scheme for the construction of a steam power station at the Artem Colliery in the Vlasovak district, near Rostoff on the Don. By agreement with the Donetz Coal Trust it is proposed to fire the boilers at the generating station with anthracite dust to be obtained at a fixed price for a period of five years. The capacity of the station is to be 32,000 kW, of which one half will be installed initially.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

The Electricity Bill.—The following is a continuation of the debate, the first portion of which was given in our last issue, on the second reading of the Electricity (Supply) Bill.

Mr. G. Balfour said the Bill conflicted with traditional freedom and constitutional practice, as it set up a new authority answerable only to a Department with a right to allocate a State subsidy. Although our consumption of electricity per head was lower than in other countries, it did not follow that we were behind them. In 1905 private power companies supplied quite small consumers far out in country areas at figures like 0.673d., 0.712d., and 1.03d., in the county of Fife, and at 0.6d. in Lancashire, prices that were never touched in the United States. The American population had increased enormously, and the new-comers had no means of light or power but electricity. In 1922 the average price of electricity in the United States was 2.66 cents. The Commonwealth Edison Co., with an output of 3,091 million kWh, supplied electricity at an average price of about 1d.; other large companies at 1.125d. and 1.3d. The Lancashire and Fifeshire companies started at too low rates, with disastrous results. The cost of electricity used in industry generally amounted to only 2 or 3 per cent. of the cost of the finished material, in the United States and in this country. The Government relied on the Weir report, but the evidence on which it was based was not before the House; he declined to accept it, as in its main conclusions it was utterly untrustworthy. It was pointed out by the Minister of Transport that the Report did not represent a definite proposal, but that under the Bill a scheme would be constituted by the Board; the Electricity Commissioners had not produced a scheme in six years: would the Board produce one in ten? The Williamson Report was issued under war conditions; the Weir Committee accepted it, and called it the Weir Report, plus certain reports by the Electricity Commissioners. The Williamson Report stated that local rating applied to electric transmission mains must greatly interfere with the supply of cheap power and that the rating of electricity undertakings should be revised; the Weir Committee said that the selected and new stations and main transmission lines should be exempted from rating, but they did not propose to exempt the electricity supply industry from rating. Some large undertakings paid in rates sums of 25 to 35 per cent. of the amount of the coal bill, but the Williamson Committee's recommendation, which would have cheapened electricity, had not been followed. With regard to the change of frequency, some of the largest non-standard undertakings had unanimously resolved to oppose it, pointing out that the cost would be many times that calculated by the Government. The benefit of improved load factor could not be given to the consumer. They would find that America had not a "grid-iron." Mr. Alexander Dow, who was quoted in the Weir Report, said the Detroit Edison System was not a closely connected unity served by several power houses; loose linking throughout the entire System was their ideal. Economy was subordinate to the first purpose of interlinking, namely, mutual assistance. Mr. A. K. Baylor said that the effect of interconnection was greater availability and reliability of power rather than reduction in the cost of supply. There was danger in linking too large regions together and causing trouble over a large area. It was a mistake to suppose that wherever the grid went the rural areas would be supplied. Mr. Baylor stated that about 60 per cent. of the cost of supply in the cities and 90 per cent. in rural districts was for delivery, so that if energy could be generated for nothing, the charges for rural supply would not be materially affected. There were more power stations relatively to the population in America than in this country. The all-in price to customers at the Luton station was 1.05d.—the price aimed at under the Weir Report by about the year 1940. The Bill was merely a competitive political stunt pressed by the Executive, and would establish a bureaucracy of departmental control.

Sir Philip Dawson supported the Bill, subject to necessary alterations in Committee. Industry, he said, had been hampered by parochial legislation. The head of the A.E.G. in Berlin constantly told him that English works were not so well equipped as those of the United States; electrical power would increase their output. Some of our modern stations were amongst the most efficient in the world, but whilst some four million people benefited by the installation of electricity, a far larger proportion of the other 30 millions ought to have cheap electricity to carry on their work and improve their homes. If they could gradually go on reducing the cost of electricity throughout the country, it would increase the use of electricity in the home and the factory. He considered that technically and economically the proposals in the Bill would be useful to the spread of the electrical industry. The Williamson Committee's conclusions were as correct now as when its report was issued, and in addition the Weir Committee benefited by the valuable experience gained by the Electricity Commissioners during six years. The Commissioners were men of great experience, and their views were supported by the consulting engineers who advised the Weir Committee. Col. Morcom said the Weir report gave a true picture of what was needed to stimulate electrical development. Sir C. Wilson had said, in effect, that in Leeds they did not want to be interfered with by anybody; that proved the necessity of a

Bill of this kind. Cheap electricity for power, with cables along our main lines of communication, would make railway electrification feasible and assist the electrical industry by the railway load. Nothing was done for London's electricity supply until practically compulsion was used to bring about agreement in the London power area. To supply cheap electricity in the Greater London area it was necessary to scrap all the inefficient stations and to have capital stations interlinked with one another. According to Mr. Alexander Dow, stations were interlinked for safety and economy; but he saw no ground for the idea that they should be solidly connected up. If the big stations knew that they were bound to co-operate they would soon come together and work out an efficient system most advantageous to all of them. The Commissioners had produced no schemes because everything was voluntary, and the people would not work together. The system of interconnection had been carried out in the United States and Germany. The standardisation of frequency was desirable, but nothing in the Bill said that the frequency would be immediately changed everywhere. The 33½ millions would be spent as, if, and when required. Frequency changers could be used if the amounts of power to be transmitted were not excessive. It was not suggested that the cost of electricity would be immediately reduced all over the country; it would be done gradually. Those who were producing cheaply should be willing and anxious to support other suppliers, so as to enable them to reduce their costs. Electricity must be pooled and sold by one selling authority; if any rights of existing companies or local authorities were endangered, he would oppose the clauses in the Committee stage. A selected station would be certain of selling practically the whole of its output, and of being paid for it, so that it would become a gilt-edged security, and there would be no difficulty in finding private enterprise to build new stations. It was not suggested that there would be immediate benefit for all rural areas, but he was satisfied that the benefits would become available gradually. When he visited Germany in 1921 with Mr. Hannon, he found the work on farms carried out by means of electricity, effecting a great saving in cost and an increase in output; waste heat from coke ovens was also used to supply gas and electricity over large areas. No body of men had helped the electrical industry more than the Electricity Commissioners, but a fundamental error would be committed if the new Board were to be a department of the Commission. It must be entirely independent; the best business men were needed, and in his opinion they could not be got together if they felt they were simply a department of another quasi-Government department. An appeal should lie to the judges or some entirely independent body. The Electricity Commissioners would continue to carry out their functions, but the great questions of policy and commercial management should be entirely in the hands of the Board and not subject to any other body. The Electrical Committee of the Federation of British Industries on March 24th resolved *nem. con.* that whilst it was in favour of the Bill receiving a second reading, it was not in agreement with various important clauses, including those governing the relations of the Board with the Electricity Commissioners. He suggested that the Board should be elected by the various interests connected with electrical supply, with an independent chairman.

Mr. LLOYD GEORGE declared that this country was in a humiliating position in comparison with other countries. It was about time we got along with the job, and if the Government could make a better job of the matter he and his friends would all be delighted to help them in committee. The Bill represented such real progress in the matter of the electrification and equipping of our industries with electrical power that he felt bound to vote for the second reading.

Sir R. BARNETT, a Unionist, said he could not vote for the second reading because he objected to the Government's setting up a bureaucracy to control a great key industry. He also disliked the financial proposals of the Bill.

Mr. SNOWDEN, winding up the debate for the Labour Party, said that the object of a publicly-owned undertaking was to supply a public need, and where there were profits, these profits were not distributed to useless shareholders, but went to the benefit of the community. This Bill was necessary because of the failure of private enterprise to give the public a satisfactory supply of electricity. Unionist members feared nationalisation through the Bill, but whether the Bill was passed or not, the sheer necessity to get relief from the inconveniences from which the public suffered would compel some Government—it might be a Tory Government—to go many steps further on the lines of nationalisation. The present measure did not go as far in that direction as the Bill of 1919. The Labour Party opposed the present Bill because it would not bring about effective co-ordination, and it did nothing at all with regard to distribution. Generation was important, but the most important thing of all was to get electric power and light in the factories and homes of the people. The Bill would do little or nothing to extend the use of electric light and power in the country.

Sir DOUGLAS HOGG, the Attorney-General, replying to the debate, said that, while the Government would, in committee, resist to the utmost any amendment designed to wreck the Bill and to destroy its usefulness, they did not pretend that improvement was impossible or that a measure of this necessary complexity could not be modified and made more useful by the united efforts of the House of Commons. There were three questions which he thought a member might have put to himself in considering whether to take the responsibility of rejecting the Bill:—(1) Is the present position satisfactory? (2) If not, what is the best remedy from a technical point of view? (3) Does this Bill embody that remedy? The Weir Committee's Report showed that the cost of electricity to the people of this country was over 2d. per unit, but if adequate generation and transmission were provided, it should not be more than a penny. That showed that the present position was not satisfactory. As to the second question, as matters were not satisfactory, what was the right remedy from a technical point of view? Here they had a very large measure of agreement. Nobody seriously challenged the position that the right way to reduce general costs was, first, to have stations in the right place and of the right size, and, secondly, to link those stations up one with another, so that they might afford mutual assistance and lead to a reduction of costs. Those were the proposals contained in the Weir Report, and they were, also, in effect, the proposals of the Williamson Committee, so far as that part of the case was concerned. There could not, therefore, be any doubt that that was, electrically and technically, the right method to adopt. Did the Bill embody that scheme? It was an essential provision on which the whole machinery of the Bill turned that by the creation of a suitable body a scheme should be worked out under which the most suitable stations should be chosen and those stations linked together, and under which the generation of electricity would take place under the most favourable conditions and at the minimum cost. He regretted the attack which had been made on the Weir Committee, and paid a tribute to the Committee's work. The Weir Committee had consulted, among others, Mr. Merz, who was called in to advise not only by the biggest electricity undertakings in this country, but by undertakings all over the world. The Weir Committee had also taken the advice of Mr. Kennedy, who was electrical adviser to the London Power Company, electrical adviser at one time to the Southern Railway, and had advised a great number of the municipal undertakings in this country and abroad. These were the electrical experts who had been so scornfully described as men with no practical experience! Mr. Samuel Insull, who had had the greatest share in developing electrical enterprise in the United States, also gave evidence before the Weir Committee, and had since stated that, in his view, the scheme embodied in the Weir Report was the only scheme which could develop and save electrical enterprise in this country. He had offered his assistance in an advisory capacity in any way the Government might desire it. Mr. Dow was also in favour of the scheme. If any independent person in the country had been asked to name the people best qualified by means of their practical experience to advise on problems of this kind, they would have selected those whose names he had given. It had been suggested that another committee should be appointed; but there came a time when, as the Weir Committee itself said, it was time to take a decision and to give up taking evidence. "We suggest," the Committee said, "on the lowest computation that the magnitude and importance of the subject demands immediate and decisive action." There had been five committees considering this problem. They all said it was urgent and that something should be done. Yet after 10 years they were told that they must appoint another committee. He was not surprised that that suggestion was put forward only by those who quite honestly said that their object was to wreck and destroy the Bill and not to make it a workable one. As far as the Government was concerned they accepted the view of the Weir Committee that it was time to take action, and they invited the House to assist them. It had been said that the power companies would not work the scheme. He thought better both of the patriotism and the common-sense of those responsible for the power companies than to take that view. The power companies ought to be as anxious as the Government was to co-operate in producing what was an urgent public need—cheaper electricity for the people. Under the scheme they were guaranteed that they would have for the current produced the whole of the cost price of its production, including amortisation and interest on the capital necessary for its generation. Why should they not produce for the public good the current which was desired from their stations when, apart from motives of civic and patriotic pride, they knew that as a result of their doing it they were guaranteed, under the full responsibility of this State scheme, the whole of the cost of their generation, including interest and depreciation of their capital? He did not believe that any power company would be so short-sighted or so selfish as to refuse to work the scheme. It had been suggested that the amount allowed for standardisation was too low. They had asked Mr. Merz and his firm to spend some time in going through one of the typical districts—Birmingham—in order to ascertain motor by motor what it would cost to effect standardisation. Mr. Merz had supplied a detailed estimate from which those responsible were able to approximate very closely to what the cost all over the country would be. It was from those figures, which had been approved by the Electricity Commissioners, that they had arrived at the figures which they had put in the Bill. If they applied to the investing public to lend £33,500,000 for this purpose on a five per cent. basis and without any State guarantee, they would not get a very adequate response. In order to cheapen the cost of electricity it was necessary to raise this money cheaply. The chairman of the London Joint Electricity Authority had given his unqualified support and approval to the Bill. No alternative proposal which had been put forward could compare with the proposals adum-

brated in the Bill, which he thought would be an unqualified success.

The Labour amendment to reject the Bill was defeated by 325 votes to 127—Government majority 198; and the Bill was then read a second time. A Unionist attempt to refer the Bill to a Select Committee instead of a Standing Committee was defeated by 416 to 45—Government majority 371.

Modernising Admiralty Generating Stations.—On March 24th Mr. Davidson, Financial Secretary to the Admiralty, informed Lt.-Commander Kenworthy that the establishments at which modernisation of the electric generating stations was being proceeded with were Portsmouth, Devonport, and Chatham Dockyards. The estimated costs were as follows:—Portsmouth, £254,000; Devonport, £166,000; and Chatham, £107,000. The work at Portsmouth and Chatham was well in hand. It would be completed at Chatham in 1926 and at Portsmouth in 1927. The Admiralty would keep in close touch with the Ministry of Transport about the progress of the general electricity scheme, but it was satisfied that there was no ground for postponing the fulfilment of the urgent needs of the dockyards on that account.

Weir Committee Witnesses.—On March 30th, Colonel Ashley informed Mr. B. Peto that the witnesses examined by the Weir Committee were:—Sir John Snell, Chairman of the Electricity Commission; Mr. A. Page and Sir H. Haward, Electricity Commissioners; Mr. J. S. Highfield, past-president, Institution of Electrical Engineers; Mr. R. A. Chattock, electrical engineer, City of Birmingham; Mr. C. H. Merz (Messrs. Merz & McLellan); Mr. J. M. Kennedy (Messrs. Kennedy & Donkin); Mr. S. Insull (Chicago, U.S.A.); and Mr. A. Dow (Detroit, U.S.A.).

"Selected" Generating Stations.—On March 30th, Mr. T. Thomson asked the Minister of Transport what was the number and capacity of the existing generating stations which it was contemplated would be selected stations when Section 5 of the Electricity (Supply) Bill became operative; and the number and capacity of existing generating stations which would not be selected stations.

Colonel Ashley referred the hon. member to Clause 4 of the Bill, where it was stated that the choice of the generating stations would be determined by the scheme which would be prepared by the Board, and submitted to the Commissioners who would inquire into the proposals. It would then be open to all interested parties to make representations on the proposals of the scheme, and only after this consideration by the Board and the Commissioners would it be possible to say which were the most suitable stations. The forecast which was contained in the Report of the Committee on National Electrical Supply, would not, of course, be binding on the Board.

An Increased Demand for Electricity.—On March 30th, Mr. Thomson asked the Minister on what investigations he had based the anticipated increased demand for electricity which, it was contemplated, would be met by the proposals contained in the Electricity (Supply) Bill.

Colonel Ashley said that the considerations on which the forecast was based were broadly set out in the Report on National Electrical Supply.

Direction-finding Apparatus.—On March 30th, Sir P. Cunliffe-Lister, President of the Board of Trade, informed Mr. Hayes that the number of British ships fitted with direction-finding apparatus on December 31st, 1925, was 263.

Bristol Corporation Bill.—On March 31st, on the second reading of this Bill, Lt.-Commander Kenworthy moved its rejection, as he took objection to Clauses 17-25, which, he said, enabled the Bristol Corporation to build a new generating station subject only to the consent of the Electricity Commissioners. This super-power station would be one of 120,000 kW; he suspected that the station was required for territory outside the city.

Col. Ashley, Minister of Transport, pointed out that the Corporation was not seeking powers to put up a station, but asked that, if and when the Electricity Commissioners should give it permission to erect a station it should be able to use land at Portishead for that purpose.

Lt.-Commander Kenworthy, however, objected to the granting of these powers. He feared that the West Gloucestershire Power Company—a private company—would be affected by the proposals of the Bill.

Mr. Hannon also took this view, and explained that the West Gloucestershire Power Company had established a station at Lydney and was already covering a large area, and he thought it would be very hard if a private company in which a considerable amount of public money had been invested should have its rights prejudiced.

Mr. R. Hudson and Sir T. Inskip denied that the interests of the Power Company would be prejudiced in any way. Sir T. Inskip said that the Corporation was determined to ask for powers to put up another station which would be adequate for the needs of its ratepayers and consumers. The Bristol Corporation area was not sought to be enlarged by this Bill, and the West Gloucestershire Power Company would have its hands full in supplying the area allotted to it.

The amendment was finally withdrawn, and the Bill was read a second time.

Legal.

Friend v. Chagford and Devon Electric Light Co., Ltd., and the Light and Power Finance Corporation, Ltd.

In the King's Bench Division on March 30th, Mr. Justice Rowlatt heard a motion for judgment in default of due delivery of a defence in the action brought by Mrs. Emma Friend, of Brixham, against the companies named above.

Mr. L. W. J. Costello, for the plaintiff, explained that the claim was in respect of preference shares which Mrs. Friend alleged she was induced to purchase by reason of false and fraudulent misrepresentations contained in two prospectuses issued by the defendants. She was making very serious allegations against the two defendants, and her case was that the whole thing was a ramp so far as those shares were concerned. In the circumstances it would have been thought that the defendants would have been only too anxious to put in a defence at the earliest possible opportunity. The statement of claim was delivered on February 9th, 1926, and under an order for directions the defence was due on February 19th. Nothing at all was heard from the defendants or their solicitors until March 9th, when they wrote a letter to the plaintiff's solicitors asking for further time in which to put in a defence. The reply of the plaintiff's solicitors was that their instructions did not admit of their giving them any more time. Nothing happened at all after that intimation. In the circumstances plaintiff waited another week to give the defendants an opportunity to apply for leave to extend the time, but as that was not done, notice of the present motion was served on the defendants on March 16th, 1926. The result of that service was that two days afterwards a document purporting to be a defence was brought to the office of the plaintiff's solicitors. That document was simply a carbon copy of another document signed by the defendants' solicitors. In the document the defendants put in a general traverse of all the allegations made by the plaintiff.

Mr. Justice Rowlatt: But if they have put in a defence now, I can't give judgment on this notice of motion.

Mr. Costello: They were a long way out of time.

His Lordship: I know; but the point of law is settled, is it not?

Mr. E. B. Calvert, for the defendants, said the defence to the action was a total and absolute denial of the allegations.

His Lordship: Oh, yes, a most eloquent denial!

Mr. Calvert: It is quite as likely to be true as the assertions now made on behalf of the plaintiff.

His Lordship: I dare say. There will be no order on the motion, except that the costs will be plaintiff's. They will be taxed and are to be paid within three weeks. If they are not paid, then the defence must be struck out.

Theft Charges.

At Old Street Police Court on April 1st, Walter F. Crispe, traveller, Mitcham, was charged on remand that being bailee of £6 15s. 9d., the money of John Eastwick, wireless manufacturer, Bunhill Row, E.C., he fraudulently converted it to his own use. Defendant was bound over for 12 months with his father as surety in £5.

At Old Street Police Court, on April 1st, Henry Vichion, a railway porter, was charged on remand with stealing and receiving a wireless condenser, the property of his employers, the London, Midland and Scottish Railway. There were now further charges against him of stealing and receiving a wireless transformer and clothing, also the property of the Company. Defendant, who pleaded "Not guilty" as regarded the transformer and the clothing, was sentenced to 14 days' imprisonment.

Patrick Corry was charged at Wigan Police Court, last week, with the theft of 140 yards of cable (value £7 4s.), the property of the Wigan Corporation. He was sent to prison for three months.

Hydro-Electric Power in Italy.—The *Board of Trade Journal* quotes some figures from a recent report relating to hydro-electric development in Italy during 1925. It is stated that during the year 55 new companies were formed with an aggregate capital of 25.1 million lire, bringing the total investment to 1,721.9 million lire. The capacity of hydro-electric stations was increased by 340,000 h.p. to 3,200,000 h.p., about 2¼ times the 1914 figure. The consumption rose from 2,400 million kWh in 1914 to 7,600 million kWh in 1925. The consumption per head in Northern Italy is between four and five hundred kWh, but in Southern Italy the figure is only 50 kWh. It is estimated that 10 million tons of coal, valued at over 2,000 million lire, was saved during 1925. The necessity of thermal stations is gradually being reduced by the construction of large reservoirs. In addition, the transmission systems between North and South Italy have the same effect. Water power in the North is most abundant during the spring and summer when the Alpine snow melts, while in the South and Central regions winter rains swell the torrents of the Apennines. At the close of 1925 there was over 45,000 km. of h.p. transmission lines in operation, about 1,600 km. of which was operating at pressures above 100,000 V.

Correspondence.

Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Private Generating Stations.

In your issue of March 26th you suggest that the Census of Production ought to furnish ample data to ascertain particulars of the above, but in your current issue it is reported that this Census is not yet available.

Now, as it has been estimated that the output (including traction) of private generating stations brings up the present annual consumption per head from 117 to 220 kWh, surely it is important that it should be somebody's job to get in touch with the owners of private generating stations, without waiting for the publication of the Census of Production. The owners of private generating stations are to be given special protection under Section 4 of the Electricity (Supply) Bill, and under Section 21 the Board is authorised to enter into arrangements with them for the purchase of their surplus electricity.

In his evidence before the Royal Commission on the Coal Industry (1925) Sir John Snell pointed out the several advantages to be obtained if owners of private generating stations joined up with a system like that which is proposed for the Central Electricity Board.

According to their annual reports, the Electricity Commissioners, under the provisions of Section 11 of the Act of 1919, have prescribed or approved the type of current, frequency, and pressure to be used at 32 new private generating stations proposed to be established during the period from January, 1920, to March 31st, 1925.

Perhaps further information could be obtained from the manufacturers of electrical generating plant, if it could be shown that such assistance would not operate to their disadvantage.

Grid.

London, *April 3rd*, 1926.

The Economical Loading of Power Plant.

The article appearing in your March 19th issue under the heading "Economical Loading of Power Plant," by Mr. J. S. Pillans appears to me to be somewhat misleading in so far as heat economy is concerned. The "Willans" lines shown in fig. 1 of the article are based on the assumption that two sets with identical steam-to-electrical conversion properties are run in parallel with the pass-out principle of steam extraction applied to one set only. The statement that the combined steam consumption of the sets is the same irrespective of loading is correct only when it is assumed that the increased steam consumption of one set is not utilised for power production. In other words, increased no-load steam consumption of the set in question.

In the case quoted by the writer, the major loading of the set, with the higher steam consumption, would be the most economical from a thermal view point, due to the saving in fuel obtained by the increased overall thermal efficiency of the plant resulting from the pass-out principle of heat reclamation.

On the other hand, take two sets, running in parallel, with a difference in steam consumption of two pounds per kWh generated, and assume that either the pass-out or bleeder method of latent heat recovery is applied to the set with the higher steam figure. In this case the resultant economy from heat recuperation would be offset by (1) increased steam consumption of the loaded set in producing the major portion of the power; and by (2) the inefficiency of running the lower steam-consuming unit on light load.

The fact remains, however, that, apart from recognised lines, there is a line of demarcation that decides overall heat economy. This may be obtained in graphical form from the potential heat expended as fuel, as ordinates, with the electrical output as abscissæ. The latter may be taken as being the criterion of efficient operation, and, in conjunction with the factor of equivalent fuel heat value, a truer and more reliable basis of comparison of power plant performance is obtained in preference to the existing antiquated and ambiguous pounds of coal and/or steam per unit generated.

W. D. W.

Hinckley, *March 29th*, 1926.

Doncaster Corporation Bill.

I have read the report of the evidence given before the Select Committee of the House of Commons as published in your issue of the 2nd instant.

I am more than surprised at the statements made by Mr. Purse, of West Ham, in referring to the South Shields Corporation Assisted-Wiring Scheme. Such statements as made by him are a direct reflection not only upon the Town Clerk to the South Shields Corporation, but also on the Electricity Commissioners, who sanctioned the borrowing of money in connection with the scheme.

I think Mr. Purse, before committing himself in the manner he did, ought to have had the courtesy to have communicated either directly with the Town Clerk or with the undersigned, who was responsible for the drafting of the scheme.

For his information I would state that the South Shields Corporation have full powers to carry out their wiring scheme in the manner in which they are doing it, under Clause 22 of the South Shields Corporation Act, 1915.

James Edgar,
Borough Electrical Engineer.

South Shields, *April 6th*, 1926.

Reviews.

The A.B.C. of Relativity. By BERTRAND RUSSELL, F.R.S. Pp. 231; figs. 7. London: Kegan Paul, Trench, Trubner and Co., Ltd. Price 4s. 6d. net.

The author of this book has a reputation which is world-wide, and well deserved, as a master of mathematical philosophy; he has also the gift of clear exposition, and abounds in happy analogies and apt illustrations: no writer of English excels him in bending simple language to the expression of difficult thought. All these qualities are much needed for the theme of the book before us, and all are conspicuously displayed. Notwithstanding this, the book demands concentrated attention from the reader. This is in the nature of the subject; but among the crowd of volumes now competing to inform the public concerning the intricacies of this difficult matter of Relativity, there are few, if any, so likely to give satisfaction to inquiring readers. Besides the Universe as conceived by Einstein, it contains some account of De Sitter's Universe which, unlike the former, does not require us to place a limitation on the infinite, or to believe in the possibility of "ghostly" stars; but makes *time* stand still where the distance is infinite. There seems some corroboration of such a possibility in the spectra of remote nebulæ, though nothing very convincing. When mathematical philosophers begin to present us with a choice of possible universes in which to believe, we begin to feel ourselves more at liberty to reject any one of them, and it may yet be that we shall come to reject them all, on the ground that the contradictions they raise are as flat as the contradictions they reconcile. At present the most simple and obvious sequence of events with which we are acquainted demands a *geodesic* to explain it, and the interval separating the events must be measured by a standard which confuses time and space in such a way that there is no telling one from the other. Such a standard is inconceivable to man. So the simplest and most obvious thing we know, is to be explained by something we cannot even conceive; as is pointed out in a book we recently noticed, "The Ego and Physical Force": and it certainly does seem odd to call such an explanation scientific. However, anyone interested in such problems cannot do better than consult Bertrand Russell's book on the subject.

Elementary Electrical Technology. By A. M. PARKINSON, B.Sc.Eng.(Lond.). Pp. x + 179; figs. 129. London: Oxford University Press. Price 6s. net.

A book on Electrical Technology would be expected, naturally, to deal with the basic science underlying some branch, or branches, of electrical engineering, but in that respect the title of the book before us is quite misleading, for it is concerned entirely with calculations on the electric and magnetic circuits. The author's main purpose is to provide the reader with an assortment of formulæ for solving problems on circuits and, having set out a number of worked examples, to give him a series of exercises in the application of these formulæ. Provided the book is used in conjunction with another which deals adequately with Electrotechnology, or is used by students attending a sound course of lectures in that subject, it may be very useful, but not otherwise.

It is a strange thing that so many writers and teachers regard the young of our species as born with an instinctive knowledge of the laws of the hydraulic circuit. Thus our author says that the loss of pressure when water flows along a pipe is "obvious," that we may discuss the hydraulic circuit and, by applying the same process of reasoning (*sic*), draw conclusions regarding the drop of pressure in electric conductors. This is merely cheating the elementary student, who is next told that "the convention for the direction of flow of an electric current is that current flows from the higher pressure to the lower pressure, *as compared with the earth* (our italics), or, as generally stated, from positive to negative." The student who really wants knowledge may search through the book in vain, however, for some hint of how he is to distinguish the higher from the lower pressure, or identify the positive and the negative. Shortly afterwards the author says that "the various terms for denoting electrical pressure are used somewhat loosely," and the reader will agree.

The beginner has few stumbling blocks in his path which are so difficult to surmount as the magnetic quantities, yet the author blithely puts him in the way of making calculations on the magnetic circuit, without ensuring that he attaches any adequate meaning to B and H.

The chapter on the alternating current circuit is by far the best part of the book, though it suffers from superficiality like the rest.

The last chapter is on the oscillating circuit, and if the students for whom the book is intended can really assimilate this, then the material in the thirteen appendices, which

contain, for the most part, concise proofs of the formulæ used in the book, might have been interspersed through its pages and the treatment might have been made more logical even if more forbidding.

Judging from the very large number of elementary textbooks which continue to be written, it appears that the difficulty of the task is not appreciated by those who essay it, and intending authors would do well to take as their model a classic by some master teacher such as S. P. Thompson's "Electricity and Magnetism."

There is evidence that Mr. Parkinson is not without qualifications for this task, but he would be well advised to lay more stress on fundamental principles.

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from March 31st, 1926:—

Timeoscope. No. 466,356. Class 8. Instruments and apparatus for use in radio-telephony and telegraphy.—Ideal Radiotelefon & Apparate Werk Gesellshaft, 10a, Rupenicker Strasse, Berlin. (British representative: Lewis W. Goold, 5, Corporation Street, Birmingham.)

Phœnix (lettering and design). No. 463,156. Class 8. Thermionic valves.—Thermionics, Ltd., 639, Salisbury House, London Wall, E.C.2.

Four Green Stripes (design only). No. 465,315. Class 8. Electric cables having braided covering.—Callender's Cable & Construction Co., Ltd.

Agnit. No. 467,088. Class 8. Instruments and apparatus for use in radio-telephony.—A. W. Lotinga, trading as Lotinga & Co., 25, Midland Street, and 47, George Street, Hull.

Lustrolux. No. 466,798. Class 13. Electric lamps (ordinary).—Lustrolux, Ltd., Albert Road, Bollington, Ches.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1924.

21,467. "Mercury-vapour lamps." J. Nisbet. September 11th, 1924. (248,796.)

21,488. "Means and methods for electrolytically treating ferrous metal objects." E. Potter (Madsenall Corporation). September 11th, 1924. (248,797.)

21,539. "Telephony and telegraphy." P. Joly. September 11th, 1924. (248,798.)

21,961. "Protection of electrical apparatus from overloads." H. Tinsley and J. H. Cox. September 17th, 1924. (248,804.)

21,962. "Control and protection of electrical apparatus." H. Tinsley and J. H. Cox. September 17th, 1924. (248,805.)

26,336. "Method of winding electrical coils of one or more layers for use as inductances and the like for radio-telegraphy, radio-telephony, and the like." E. R. Lees. November 5th, 1924. (248,809.)

28,664. "Wireless receiving apparatus for eliminating disturbances." L. Levy. November 30th, 1923. (225,570.)

29,338. "Submarine cable and like telegraph systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 6th, 1924. (248,822.)

29,339. "Submarine cable and like telegraph systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 6th, 1924. (248,823.)

29,586. "Electric cooking stoves." W. Guy-Pell. December 9th, 1924. (248,825.)

29,591. "Telephone systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (B. A. Turkhud). December 9th, 1924. (248,826.)

29,701. "Cracking of either liquid or readily-fusible organic complexes by means of an electric arc." C. Longhi. December 10th, 1924. (248,830.)

29,738. "Receivers for type-printing telegraphy." R. S. Smith. December 10th, 1924. (248,836.)

29,784. "Telegraphic transmission of pictures, diagrams, and other impressions." T. Thorne-Baker. December 11th, 1924. (Cognate application, 3,957/25.) (248,837.)

29,804. "High-frequency signalling systems." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 11th, 1924. (248,838.)

29,815. "Control gear for electric motors operating winches or other machinery." British Thomson-Houston Co., Ltd., and R. D. Given. December 11th, 1924. (248,840.)

29,932. "Loud-speakers for wireless-telephony and the like." J. S. R. James. December 12th, 1924. (Cognate application, 14,482/25.) (248,845.)

30,008. "Inductance and electrical coil." L. C. Turner. December 13th, 1924. (248,849.)

30,041. "Circuits of two-grid valves." Compagnie Générale de Télégraphie sans Fil. December 15th, 1923. (Addition to 223,580.) (226,228.)

30,052. "Plug-and-socket connectors for electrical apparatus." J. H. Hewitt. December 15th, 1924. (248,850.)

30,122. "Electric hand warmers adapted for attachment to the steering-wheels of motor-cars and the like." T. O'M. Farrell. December 15th, 1925. (248,852.)

30,135. "Positive electrodes for electric batteries." Soc. Anon. Le Carbone. November 19th, 1924. (243,300.)

30,136. "Variable electric condensers." B. Hesketh. December 15th, 1924. (248,855.)

30,427. "Means for supplying electric current to wireless apparatus from direct-current supply mains." F. Baker & Sons, Ltd., and F. C. Clarkson. December 18th, 1924. (Cognate application No. 3,118/25.) (248,861.)

30,428. "Means for supplying electric current to wireless apparatus from direct-current supply mains." F. Baker & Sons, Ltd., and F. C. Clarkson. December 18th, 1924. (248,862.)

30,603. "Electric accumulators." Chloride Electrical Storage Co., Ltd., and H. Dean. December 19th, 1924. (248,865.)

30,712. "Wireless systems." B. H. N. H. Hamilton and J. Robinson. December 20th, 1924. (248,868.)

30,770. "Telephone exchange systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 22nd, 1924. (248,869.)

30,796. "Low-frequency or other electric transformers." H. Weiland. December 22nd, 1924. (Convention date not granted.) (226,815.)

30,944. "Electric couplings." W. E. Barber and H. A. Watts. December 24th, 1924. (248,870.)

30,974. "Coke ovens and batteries thereof." Koppers Co. April 10th, 1924. (232,173.)

30,976. "Electric couplings." J. A. Crabtree. December 24th, 1924. (248,871.)

31,360. "Radio-receiving apparatus." C. E. Ogden and P. V. Ogden. June 30th, 1924. (236,156.)

1925.

292. "Wireless receiving circuits." H. Tyler. January 5th, 1925. (248,876.)

1,630. "Electric accumulator casings." W. Haddon. January 19th, 1925. (248,881.)

1,882. "Automatic electric circuit breakers." E. M. Johnson, G. A. Juhlin, W. H. Thompson, and Metropolitan-Vickers Electrical Co., Ltd. January 21st, 1925. (248,883.)

2,174. "Apparatus for heating or cooking by electricity." Sir F. W. S. Stokes. January 24th, 1925. (248,884.)

2,857. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and J. E. Ostline. January 31st, 1925. (248,891.)

3,361. "Electric cables." British Insulated Cables, Ltd. (formerly British Insulated & Helsby Cables, Ltd.), and H. G. Nisbett. February 6th, 1925. (248,896.)

3,603. "Circuit arrangements for automatic telephone systems and the like." Siemens Bros. & Co., Ltd., and W. G. Patterson. February 9th, 1925. (248,899.)

3,736. "High-frequency two-way telephone systems." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). February 10th, 1925. (248,900.)

3,959. "Thermionic discharge devices." Westinghouse Electric & Manufacturing Co. February 20th, 1924. (229,655.)

4,989. "Electro-acoustic devices." Marconi's Wireless Telegraph Co., Ltd. (J. P. Minten and A. S. Ringel). February 23rd, 1925. (Convention date not granted.) (229,706.)

5,695. "Spark plugs and method of making same." E. C. R. Marks (A. C. Spark Plug Co.). March 2nd, 1925. (248,915.)

5,817. "Signal device for indicating a broken electric circuit." A. A. Thornton (Telatail Co.). March 3rd, 1925. (248,919.)

5,954. "Electrical terminals." Belling & Lee, Ltd., C. R. Belling, E. M. Lee, and H. O'Connell. March 4th, 1925. (248,921.)

6,373. "Loaded signalling conductors." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). March 9th, 1925. (248,922.)

6,802. "Electric transformers." S. Z. De Ferranti and Ferranti, Ltd. (Cognate application, 13,890/25.) March 12th, 1925. (248,925.)

6,982. "Variable-capacity electric condensers." Igranic Electric Co., Ltd., and F. R. Griffiths. March 14th, 1925. (248,928.)

7,004. "Holders for inductance coils." A. P. Portway and Goswell Engineering Co., Ltd. March 14th, 1925. (248,929.)

8,483. "Electric insulators and means for making the same." R. Haddan (Corning Glass Works). March 30th, 1925. (248,934.)

9,336. "Means for receiving alternating-current signals." F. E. Pernot. April 8th, 1925. (248,941.)

9,401. "Electric cells." C. Gaiser. April 8th, 1925. (248,942.)

11,364. "Cathodes for electric discharge devices." General Electric Co., Ltd., and M. Thompson. May 1st, 1925. (248,956.)

11,554. "Amplifying tubes for wireless telephony." Schweiz Gluhlampenfabrik Akt.-Ges. and K. Burk. May 7th, 1924. (233,697.)

12,672. "Mounts for coils used in wireless apparatus." H. E. Bowen. May 15th, 1925. (248,964.)

13,204. "Manufacture of non-sagging spiral filaments of highly-refractory metal." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. May 24th, 1924. (234,489.)

13,348. "Manufacture of electric cables." B. Kolanczyk. May 21st, 1925. (Addition to 218,975.) (248,968.)

13,593. "Electromagnetic apparatus for recording or reproducing sound or like vibrations." British Thomson-Houston Co., Ltd. July 21st, 1924. (237,223.)

13,923. "Electric rotors and their method of manufacture." W. J. Mellersh-Jackson (L. Allis and E. B. H. Tower, Jun.). May 27th, 1925. (248,970.)

14,156. "Process and apparatus for increasing the ultra-violet radiation from mercury-vapour lamps made of quartz." H. George. May 30th, 1924. (234,834.)

14,717. "Electric switches." Benjamin Electric, Ltd. June 5th, 1924. (235,221.)

15,820. "Apparatus for use in installations for amplifying electric oscillations by means of discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. June 20th, 1924. (235,904.)

16,380. "Supply of electric power to high-frequency signalling systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). November 13th, 1924. (242,948.)

18,405. "Ignition apparatus for internal-combustion engines." A. R. Müller. July 19th, 1924. (237,280.)

19,074. "Electrical accumulators." A. Wiener. May 30th, 1925. (249,004.)

19,659. "Headlights for motor vehicles." C. F. Young. August 26th, 1924. (239,183.)

20,064. "Combined switches and wall connectors." C. L. Arnold and M.K. Electric, Ltd. August 10th, 1925. (249,006.)

20,386. "Loud-speaking telephones." Marconi's Wireless Telegraph Co., Ltd. August 15th, 1924. (238,558.)

21,623. "Electrolytes for lead accumulators." A. J. Andre de la Porte. August 28th, 1925. (249,016.)

22,776. "Methods of and means for the telegraphic transmission of pictures, diagrams, and other impressions." T. Thorne-Baker. December 11th, 1924. (Divided application on 248,837.) (249,020.)

22,777. "Telegraphic transmission of pictures, diagrams, and other impressions." T. Thorne-Baker. December 11th, 1924. (Divided application on 248,837.) (249,021.)

22,840. "Regulating of motors fed by constant current." Siemens-Schuckertwerke Ges. September 13th, 1924. (239,882.)

24,390. "Electric gas purifier plants." Siemens-Schuckertwerke Ges. October 1st, 1924. (240,844.)

25,001. "Magnetic testing apparatus." British Thomson-Houston Co., Ltd. October 8th, 1924. (241,203.)

27,183. "Sealing-in machines for the manufacture of electric incandescent lamps and the like." Naamlooze Vennootschap Philips' Gloeilampenfabriken. November 4th, 1924. (242,628.)

27,292. "High-frequency device for electromedical objects." K. G. Sikor. October 31st, 1924. (242,302.)

28,740. "Oscillatory circuits and tuning means therefor." Telefunken Ges. für Drahtlose Telegraphie. November 15th, 1924. (243,018.)

29,347. "Electric motors." British Thomson-Houston Co., Ltd. November 29th, 1924. (243,717.)

29,382. "High-frequency transformers." Soc. Française Radio-Electrique. November 21st, 1924. (243,379.)

29,521. "Electric motors." British Thomson-Houston Co., Ltd. November 29th, 1924. (243,720.)

30,133. "Illuminating appliances." Holophane, Ltd., and E. Stroud. November 28th, 1925. (249,046.)

30,303. "Automatic shunt resistance for lamps or the like in series." Dr. A. Lampl. May 9th, 1925. (249,048.)

30,361. "Spark plugs for internal-combustion engines, and method of cooling the same." H. Fischer. December 4th, 1924. (244,090.)

30,513. "Electron-discharge devices." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 2nd, 1924. (Divided application on 28,882/24.) (249,049.)

30,896. "Means for securing bolts in electric insulators." Siemens-Schuckertwerke Ges. December 15th, 1924. (244,459.)

1926.

1,145. "Submarine and the like cable signalling systems." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.) (Western Electric Co., Inc.). December 6th, 1924. (Divided application on 248,822.) (249,057.)

1,957. "Junction boxes for electric lead-covered cables and the like." E. C. R. Marks (Max Sieverts Fabriks Aktiebolag). November 7th, 1924. (Convention date not granted. Divided application on 26,650/24.) (246,563.)